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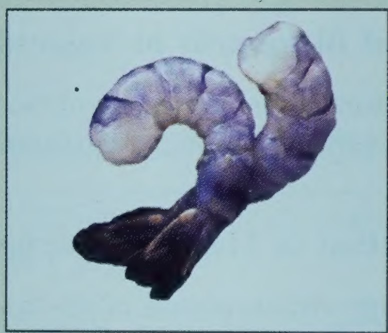

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FISHING CHIMES

.... Towards Dawn of Nation-wide Export-oriented Aquaculture Era

(Of *Giant Prawn, Black Tiger and Nile Tilapia*)

A shift in the aquaproduction scenario of India towards shrimp that crept in some years back has now manifested itself. The reason: Marine capture fisheries output that was the sheetanchor of the national fish production plummeted to its lowest level over years. As part of this trend capture shrimp production has faithfully followed in sympathy. In this situation, fortunately, culture fish production came as the saviour and restored the overall national trend. However, this remedial adjustment has left in its wake two shrotcomings. One is that the increase in culture fish production has been mostly in respect of major carps which have no export value and the increase in their production has led to diminishing returns to the farmers. Another is that Black Tiger (BT) and giant freshwater prawn (GFP), while having marginally added to overall national ouput and have contributed to augmenting exports and earnings thereof, farmers and exporters could not earn much of profits because of the depressed global aquafood market situation. The outlook is fortunately improving now.

This situation clearly points out an inescapably unitary line of action to increase export-oriented production, i.e., working towards the dawn of nation-wide increase in GFP and BT culture production. Farmers have to be enabled to diversify into culture of Nile/GIFT tilapia too which has a strong export market, mainly to USA, in whole as well as filleted form. In this background, there is an indisputably emergent responsibility on the part of the authorities concerned to draw up and set in motion an aggressively bold policy to promote the spread of the culture of these species over the length and breadth of the country, of course barring the temparate zone where they do not survive.

An appraisal of the present scenario and the indications that it throws for the authorities to act upon in respect of policy formulation, ncreasing production, augmenting incomes of farmers and stepping up exports is attempted hereunder.

Giant Freshwater Prawn (GFP) : *An estimated 30,000 ha of water area supported by over 70 hatcheries has been developed in the coastal states. In inland states such as 'Madhya Pradesh, Punjab, and Haryana, also there has been some measure of GFP culture coverage. A begining has been made by the farmers of Punjab and Haryana who brought 10 and 3 acres of water area respectively under GFP culture. The credit for this initiation goes to the Central Institute for Freshwater Aquaculture, whose unit in Ludhiana has made this possible. In fact, very recently, 80,000 PLs of the species from CIFA, Bhubaneswar, and 60,000 pls from Nellore in A.P were airlifted to these States. The cost of this transport is stated to have come to a reasonable 85 p per piece. Earlier 35,000 airlifted pls were stocked in 3 acres of area in the zone yielding a production of 1.3 t 1ha in one farm and 2 t 1ha in another farm. This demonstration has led the Government of Haryana to allot Rs 2.75 crores for the promotion of GFP culture in the State, mostly because of the initiative excercised by Ms. Asha Sharma, Secretary (finance) and Commissioner (Fisheries) Haryana. The Director of Fisheries, Haryana, has the distinction of setting in motion measures for promoting the activity. It is learnt that Amalgam Group with head quarters in Kerala and an office in Delhi has offered to extend marketing assistance to Haryana and Punjab farmers both within the country and for export as well.*

In Madhya Pradesh a promising beginning in GPF seed production has been made by Prof. T.A. Qureshi of Barkatullah University using constituted sea water. A modest start has also been made by the farmers of Chattisgarh State by getting GFP seed from AP and stocking their tanks with them. In fact, after its formation in November 2000, the new State has shown keen interest in the promotion of prawn farming. It is learnt that the State Cabinet has taken a decision in prinicple to go in for a joint venture with an Indian entrepreneur to demonstrate commercially viable and exportable potential of GPF farming. Trials in this regard have already begun at Demar Fish Farm (Dhamtari) in an area of 4 ha, by an Andhra Pradesh-based entrepreneur. Apart from this, polyculture with GPF has been also initiated at six places. This consists of polyculture of ***Macrobrachiumi malcolmsonii*** *(River Prawn) with fish and this is being done in Ambikapur and Raigarh. Monoculture of* ***M.rosenbergii*** *alone has been taken up in Jagadalpur, Dantewara, Bilaspur and Durg areas. At Dantewara and Jagadalpur, prawn seed is supplied on 100 % subsidy basis to tribals. The prevailing interest in prawn farming is no doubt a welcome feature but there are a few aspects which need to be looked into. In Tripura, a GFP hatchery has been set up by the State Fisheries Department.*

In Andhra Pradesh itself, 22,084 ha in the coastal zone and

259 ha in the interior (Telangana area), far away from the sea coast, have been developed for GFP culture, yielding an annual production of 20,910 t (2000-2001). In Kerala, Karnataka, Maharashtra, Orissa and West Bengal too a considerable extent of area has been brought under GFP culture.

Considering the stage set for making a headway in promoting GFP culture so as to achieve an addition to aqua product exports, MPEDA may have to think of drawing up a massive plan on a priority basis, for extending GFP culture to all amenable water resources in the country. This plan can include measures for a quick estimate of lentic resources that can be developed for GFP culture and the kind of organisational mechanism needed for the seed of GFP to be taken from coastal centres to the States concerned (by air, van, relay shifting), their acclimatisation, storage, and supply to farmers, monitoring of culture endeavours, creation of channels for pooling up catches, their preservation, storage and transport to exporting outlets (harbours). The task is no doubt arduous but it is feasible and deserves to be undertaken for the beneficial utilisation of the resources and for augmenting exports.

MPEDA, the Union Fisheries Division, ICAR's Fisheries research wing, and state fisheries departments need to openly express their views on the subject in order to provide strength to the movement already started in Haryana, Chattisgarh etc., so as to contribute to the national wealth. With its expertise MPEDA can certainly pave the way for significantly contributing to the preparation of a project (after receiving a mandate from the various States). The project can provide for quick surveys of water resources, and for institution of pilot schemes involving training programmes too in each of the States and later embark upon a follow-up expansion phase in the light of the pilot phase results. The existing organisational set up in the form of FFDA can well be utilised for this development programme. MPEDA can also come up with a scheme for providing handsome subsidies, to be shared by the State Fisheries Departments and Union Fisheries Division. The training costs can also be subsidised. The suggested project could include provision for infrastructure needs such as centralised seed storage units, centralised ice plants, product storage and processing units and transportation and marketing facilities. It is encouraging that Mr. Tarakan, Chairman of Amalgam group, has already inducted his Delhi unit into the activity.

Regarding BT culture, there are clear cut possibilities of culturing these in the saline zone of Haryana, Punjab and Western U.P. The main need that can arise in this venture is to bring down the salinity of water to 15-20 ppt by taking in freshwater from nearby Indira Gandhi canal or other sources. The other constraint is related to seed supply. By setting up centralised seed storage farms, PLs brought in by air-cum-road transport method can be stored in them and utilised for stocking farms to be set up in the zone. Through a devoted and consistent effort, the required infrastructure facilities can be developed by the state governments concerned. In the alternative, a commercial organisation can be encouraged to set up the infrastructure by providing land and other facilities. There can be no problem of salinisation of adjacent agriculture fields on account of promoting the farms for the reason that the entire zone is saline. In Thailand, salinity problem in rice fields is experienced because sea water is taken inland through canals for feeding shrimp ponds and there was the incidence of salinity from canal waters seeping into adjacent fields. No such contingency can arise in the case of saline lands converted into shrimp farms in the states mentioned.

So far as the extension of BT culture in freshwater ponds is concerned, some have reservations about the feasibility of this practice. They believe that culture of BT in freshwater can be possible only where there is some measure of bottom soil salinity. This cannot be correct as BT culture is being conducted in several tanks which have no bottom soil salinity any more than in the areas farthest from the sea. Presuming that there can be such a problem in the freshwater tanks/ponds in the States far away from the coast, the issue can be resolved by taking up a pilot project covering selected tanks and ponds in the States such as Madhya Pradesh, Bihar, eastern U.P etc. The results of the pilot programme will resolve the issue once and for all. Infact, Dr. K. Gopakumar, former Deputy Director General (Fisheries), ICAR exhorted the farmers of MP to take up BT culture in their ponds, at a seminar held a couple of years back in Bhopal.

*Turning to Tilapia, it is good to know that atlast, the Ministry of Agriculture is convinced that the exotic Nile Tilapia (**Tilapia nilotica**) needs to be allowed to be imported into the country. Apparently, the ministry is swayed by the consideration that the fish has an enormous potential as an exportable commodity. Two companies, one of which is Water Base Ltd, have now the permission to import Nile Tilapia, it is learnt. They can now set up dedicated farms at centralised locations, where monosex seed of the species can be produced and supplied to the farmers. In this context, many would not agree with the view of Dr P.K.Ramachnadran, Vice-President, Water Base Ltd, Chennai, published as part of an interview he gave to **Aqua feed** (Vol 5, issue 1, 2002) that Tilapia has no local market in India. While his perception may be in order, the permission given for introducing the fish in India is apparently not for meeting the domestic demand, but is meant mainly to cater to the surging demand principally in USA for whole dressed Tilapia and also its fillets in IQF or block-frozen form. He has not however mentioned this aspect in his interview. In any case there must have been a motivation for seeking and securing the relaxation from the government to culture this fish.*

In conclusion, we appeal to MPEDA to formulate a project as indicated above, seek approval of the government and co-ordinate its implementation, in order to mobilise the efforts of lakhs of inland fish farmers for producing aqua crops that have export orientation too. These efforts, over a period of time, would go a long way to counteract the declining trend of exports. As Robet S.Hooey of Aquastar says, Indian GFP and BT, have gained good acceptance in US market and this is a positive signal to produce more of them mainly for export.

Saline water resources of Rajasthan and their suitability for brackishwater aquaculture

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Saline water resources are found almost in all continents of the world including Indian sub-continent under varied conditions of soil and climate.

Natural availability of saline water is attributed to various climatic and hydro-geological factors. Apart from this, various human welfare and developmental activities have also led to large scale salinisation of agricultural lands. There are however serious constraints in the growth of agriculture and socio-economic development in the zones having such saline water resources.

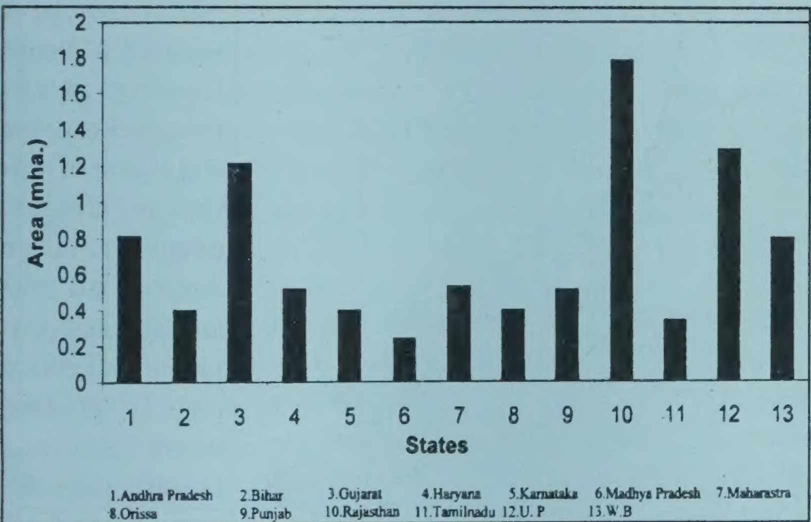

Fig 1: Distribution of salt affected lands in India

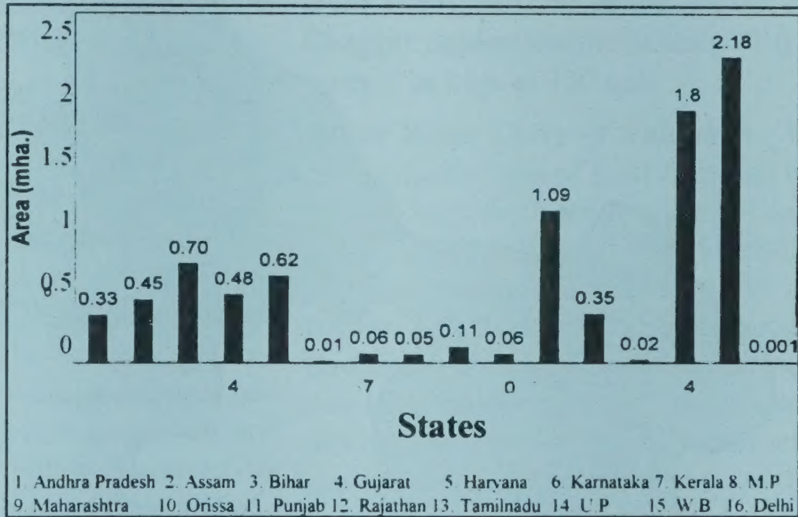

Fig 2: Distribution of water logged lands in India

Origin of Inland Saline water Resources

Availability of saline water resources in inland regions of India is mainly attributed to natural origin of salt affected soils, and consequential availability of ground saline water and resultant water logging of lands due to increasing net work of irrigation system.

Salt affected soil : Salt affected soils have been known to occur since ancient times in the Indus and Gangetic plains in the north of India. The origin of salt affected soils is attributed to geological, climatic and hydrological factors. These soils do not occur extensively in humid areas because the salts are continuously leached out of the soil in these areas by excessive rain water. However, in semi-arid and arid regions where rainfall is less than evaporation, accumulation of salts in soils is manifested several folds and as a result vast tracts of salt affected soils occur in semi-arid and arid regions. The total extent of salt affected soils in India which was earlier estimated to be 8.5 mha.(Joshi and Tyagi, 1984) is now estimated to be 9.23 mha. (Fig.1). A soil is said to be salt affected when salts are accumulated in the root zone to such an extent that they adversely affect yield of normal crops. Salt affected soils are divided into two broad categories i.e., saline soils and alkali (sodic) soils.

Saline soils : Saline soils, commonly known as "Noone" are dominated by chloride and sulphate salts of calcium, magnesium and sodium. The electrical conductivity (EC) of saturated extracts at 25°C is above 4 ds/m. where pH is below 8.5 and exchangeable sodium percentage (ESP) is less than 15. Six classes of saline soils are found in India. These are: 1) Saline soils of semi-arid and arid regions with high saline ground water; 2) Saline soils of sub-humid regions with moderate saline ground water,; 3) Saline soils of sub-humid delta region; 4) Saline soils of semi-arid delta region; 5) Saline acid sulphate soils of humid regions, and 6) Saline marshes of arid regions.

Alkali or sodic soils : Alkali soils, commonly known as *Kallar/Reh/Usar* are dominated by carbonate and bicarbonate of sodium. The estimated salt percentage (ESP) of such soils is above 15, pH in between 8.5 and 10.0 and variable electric conductivity (EC). The alkali soils of India are categorised into three classes as indicated hereunder :

1) Alkali soils of Indo-Gangetic plain with sweet ground water; 2) Alkali soils of Indo-Gangetic plain with sodic ground water; and 3) Alkali soils of the Deccan Plateau with sodic or saline ground water.

Ground water resources : About 41-84% of ground water is of saline to saline-sodic nature in inland States of India, maximum being in Rajasthan

Table-1 : Groundwater Resources and their Quality in North-West States of India.

Characteristics	*Punjab*	*Haryana*	*UP*	*Rajasthan*
1. Geographical Area (mha.)	5.0	4.4	29.4	34.2
2. Arid Area (%)	26.8	29.3	Nil	57.4
3. Semi-arid Area (%)	60.2	59.7	70.0	36.7
4. Mean Annual rainfall(mm)	611	556	836 (W)	700 (E), 300 (W)
5. Ground water Resources (mha-m/yr) Utilisable	1.31	0.88	9.27	1.83
6. Ground water quality(%)				
Good	59.0	33.0	37.0	16.0
Marginal	22.0	8.0	20.0	16.0
Poor	19.0	55.0	43.0	68.0
7. Quality of poor water(%)				
Saline	22.0	24.0	NA	16.0
Sodic	54.0	30.0	NA	35.0
Saline-sodic	24.0	46.0	NA	49.0

(Source: Central Soil Salinity Research Institute, Karnal)

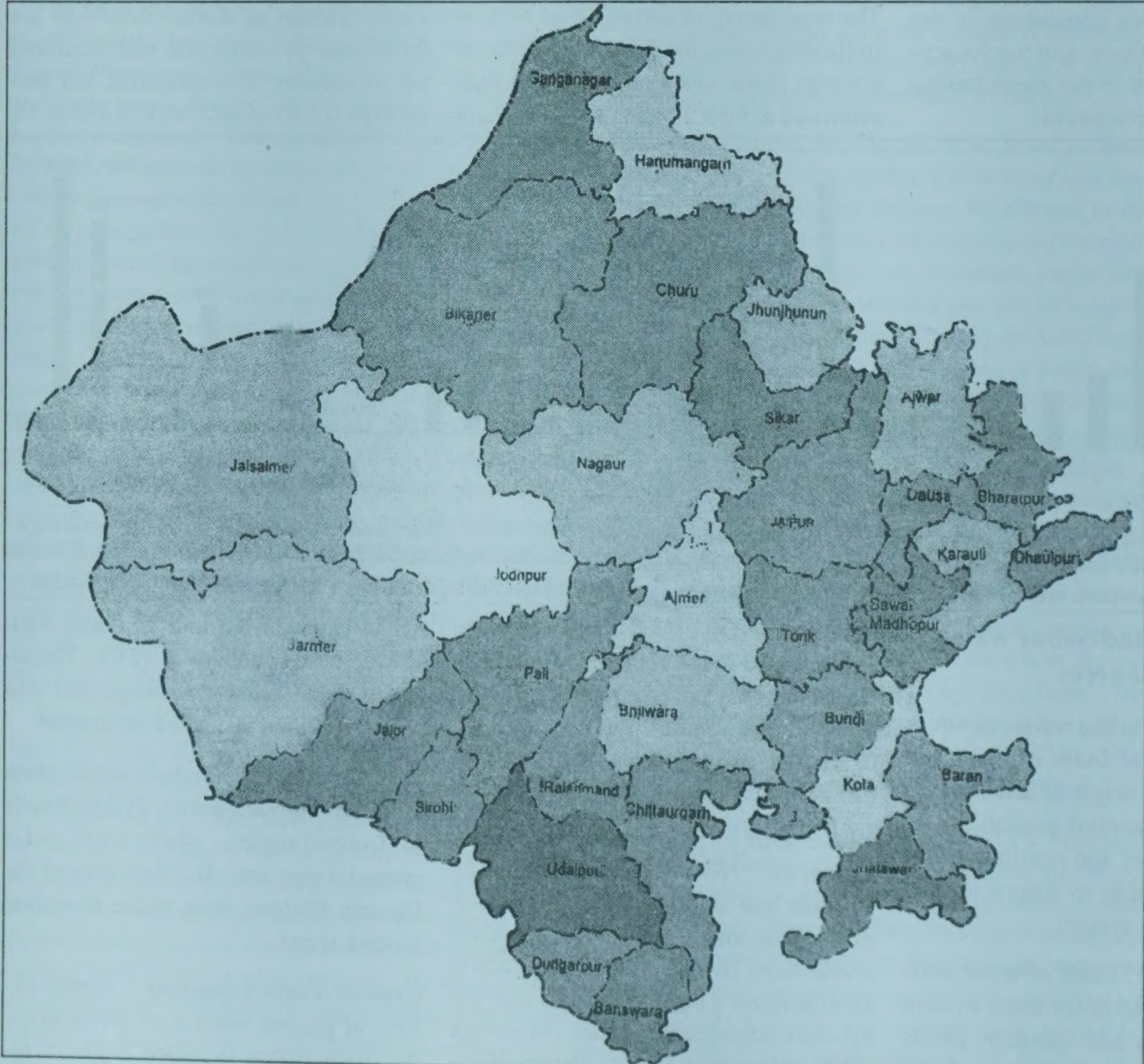

Fig 3: Location of different districts in Rajasthan

(Table-1). The salinity of ground water could be attributed to geographical and topographical factors. The districts of western Rajasthan and Rohtak, Jind, Hisar, Bhiwani, Sirsa and Mohindergarh districts in Haryana are underlain with saline water aquifers. Similar conditions are also found in parts of Faridkot, Bhatinda and Ferozpur districts of Punjab. The incidence of sodic waters occur, mainly in semi-arid parts with annual rainfall of 50-70 cm. Such waters are common in Agra, Mathura, Aligarh, Mainpuri, Etah, Ballia and few more districts of UP and also in eastern districts of Rajasthan.

Water logged lands : Continuous and repeated water logging of agricultural lands is another major cause of secondary salanisation. Water logged lands have developed due to increasing network of surface irrigation canals. Extensive seepage of water flowing in canals, reckless use and waste of water in drains, poor drainage and run off system for rain water etc., all add to rise in ground water table and to subsequent development of water logged lands. It is estimated that 15-20% of the total command area of major and medium irrigation projects have become afflicted with the menace of salinity and water logging. As per estimates of Ministry of Agriculture (1984-'85) total

Table-2 : District-wise Distribution of Salt Affected and Water-logged lands in Rajasthan

(Area in hectares)

S.No.	District	Salt affected	Water logged
1.	Ajmer	7,685	-
2.	Alwar	7,437	-
3.	Banswara	-	-
4.	Barmer	31,000	-
5.	Bharatpur	4,560	-
6.	Bhilwara	6,250	-
7.	Bikaner	1,367	2,148
8.	Bundi	315	-
9.	Chittaurgarh	315	-
10.	Churu	2,006	-
11.	Dhaulpur	-	-
12.	Dungarpur	-	-
13.	Ganganag. & Hanumangarh	-	3,098
14.	Jaipur & Dausa	5,250	-
15.	Jaisalmer	20,880	620
16.	Jalore	27,265	-
17.	Jhalawar	-	-
18.	Jhunjhunun	-	-
19.	Jodhpur	17,383	-
20.	Kota & Baran	315	-
21.	Nagaur	18,155	-
22.	Pali	2,190	66,560
23.	S.Madhopur & Karauli	-	-
24.	Sikar	2,405	-
25.	Sirohi	-	-
26.	Tonk	23,938	-
27.	Udaipur & Rajsamand	-	-
	Total	**178,716**	**72,426**

* It has increased by several folds.

(*Source: Ground water Atlas of Rajasthan*. 1999)

extent of water logged lands in India is 8.53 mha. (Fig.2)

The average rate of water table-rise in most canal irrigated areas is 8-34 cm per year. In the State of Haryana 52% of total geographical area of 4.4 mha. is confronted with rising water table having net recharge volume of approximately 0.23 x 109m^3/year which is about 10 mm net depth of water. The total area affected by water logging and water table within a depth of less than 3 m is about 0.6 m ha. or 15% of area of Haryana State. The water table rise in command area of Indira Gandhi Nahar Pariyojana (IGNP) in the State of Rajasthan is 0.63-0.99 m/yr. Once the water table rises within 2-3 m of the soil surface, as a result of continuous rise, it contributes substantially to evaporation from the soil surface and water uptake by plants. The upward flux of water due to evaporation and water uptake by plants results in gradual concentration of salts in the shallow depths of soil profile and make the soil unfit for agricultural use.

These resources are expected to further increase in future as a result of large scale development of irrigation canal network. The environment action plan, on Sardar Sarovar Dam being constructed across river Narmada with a 458 km. long irrigation canal for Gujarat and Rajasthan, indicated that the project is not environmentally sound and may lead to water logging and salinity problems causing serious threat to agriculture production. Thus, the technical, operational and management parameters of the project are again being reviewed to make it sustainable and environment friendly.

Saline Water Resources of Rajasthan

Rajasthan is the largest State in Indian sub-continent (Fig.3). It covers an area of 34.2 mha and stretches between 23^{0}3' N to 30^{0}12' N Lat and 69^{0}30' E to 78^{0}17' E long. Major part of the State is covered under semi-arid and arid climate. All the three factors viz., salt affected soils, ground water salinity and water logging of lands contribute to the availability of saline water in the State.

The total extent of salt affected soils in Rajasthan which was earlier reported to be 1.12 mha (Joshi &Tyagi, 1994) is now estimated to be 1.78 mha (Table 2). It mainly covers several districts such as Barmer, Jalore, Jaisalmer, Nagaur, Jodhpur, Ajmer, Alwar, and Bhilwara. The underground water is moderate to highly saline (>200 ppt) in most of the western districts including few districts of central and southern Rajasthan viz., Pali, Bhilwara, Bharatpur, Ajmer, Alwar, Jaipur, Tonk, Kota, Sawai Madhopur, Nagaur and Chittorgarh. 24,430 ha. agricultural land was reported to have of become water-logged in the command area of Indira Gandhi Nahar Pariyojna (IGNP) in the western Rajasthan (Hooja *et al.* 1995). In some of the pockets of Ghaggar depression the salinity of the water is as high as 150 ppt.

Saline Water Lakes of Rajasthan : In the catchment area of Luni river and its surroundings there are few saline lakes viz., Didwana, Panchpadra, Sambher and Kuchaman. In the districts of Bikaner and Barmer, Pokharan, Falodi, Bap and Lunkarnsar the important saline lakes are located. All these lakes receive rain water during monsoon season which becomes saline due to the presence of salt in the lake bed. Most probably these salts have accumulated in the lake bed due to continuous extraction of ground saline water for common salt production.

Sambhar Lake : Sambhar lake is the largest saline water lake of Rajasthan situated between 27-29^{0}N Lat and 74-

Table-3 : Total extent of Water-logged lands in IGNP command area (Area in ha)

S.No.	Area*	Stage I		Stage II
		1992-'93	1993-'94	1992-'93
1.	Potentially Sensitive Area	2,02,960	1,60,760	17,900
2.	Critical Area	22,000	17,760	4,000
3.	Waterlogged	13,750	9,680	1,000

(Source : Hooja *et al.* 1995)

75°E Long. The lake is located at the border of Nagaur and Jaipur districts. Total length of the lake is about 32 km from north to south whereas in breadth it extends 3 to 12 km from west to east. Maximum area of the lake is around 234 sq km during monsoon and it shrinks to 130 sq km during summer months with water availability restricted to small pockets. The salinity of the water is the highest before rains. The lake has an estimated quantity of 35 crore t of common salt. There are a large number of salt manufacturing units around the periphery of the lake. The Hindustan Salt Ltd. is the major manufacturer of Sodium Chloride (common salt) and Sodium Sulphate is also produced here.

Deedwana Lake : Deedwana lake is located in Nagaur district near Deedwana town as a saltwater depression. It is about 4 km in length and 2 km in breadth. The lake is surrounded by sandy hills on all sides except in the west where an isolated spur of the Aravalli forms its western boundary. The lake bed is characterised by black clay which is similar in appearance to that of the Sambhar lake. The salinity of ground water is as high as 200 ppt at higher depths. These waters are also used for common salt manufacture.

Pachpadra Lake : This lake is situated near Pachpadra in Bikaner district. It covers an area of 25 sq km. The salt of Pachpadra is akin to sea salt. The salt pits in this area are scattered over an area of about 5 sq.km.

Lunkarnsar Lake : This lake is also situated in Bikaner district near Lunkarnsar town. It covers an area of about 6 sq km. This saline water resource is also used for producing common salt.

Indira Gandhi Canal Project (IGNP)

Indira Gandhi Canal Project is the biggest agro-irrigational project in western Rajasthan. The main feeder canal, which brings water from Harike barrage on the Ravi-Beas-Sutlej system to the State of Rajasthan, is 204 km. long. The main canal which flows through Ganganagar, Bikaner and Jaisalmer districts is 445 km long. The total length of distribution system is 8,190 km (Flow area 5898 km; Lift area 2292 km). The total culturable command area under the project is 15.43 lakh ha. The IGNP has considerably improved the economy and the socio-economic status of the people of the region. However, it also caused water logging and secondary salinisation in large areas due to continuous rise in water table. The water table rise in the IGNP command area is reported to be 0.70 m (minimum) to 1.17 m (maximum). The total extent of water logged area in IGNP was estimated to be 24,430 ha. during 1992-94 (Table-3)

Potentially Sensitive Area : Water table is 1.50-6.00 m below the ground level.

Critical Area : Water table is 1.00-1.50 m below the ground level.

Waterlogged Area : Water table is < 1.00 m below the ground level.

In most part of the IGNP command area the ground water quality is saline. The water quality is reported to deteriorate further wherever ground water has risen to surface. The stagnant water at ground surface is graded as unfit for human and animal consumption and also for irrigation. The EC value indicates that the fresh ground water is available only in 12.83% of command area.

Ground Saline water potential

The ground water potential depends upon the nature of rocks and their water bearing capacity. Approximately 40% of the State is occupied by hard rocks which have negligible primary porosity. However, the blown sand and alluvium which occupy 60% of the State contains moderate to most productive aquifers and the quality of ground water of these aquifers is saline. The water yield potential of these aquifers is 50-300 cum/day. Hence, good availability of ground saline water could be assured at most of the places where saline water is found. Ahore and Sanchoe blocks of Jalore district, Bilara, Shergarh and Luni blocks in Jodhpur district, Degana and Kuchaman in Nagaur district and Rohat and Pali blocks in Pali district have surplus saline ground water with shallow water tables and vast stretch of waste land.

Ground water Appraisal of Rohat Block of Pali

Availability of ground water in saline alluvial zone of Rohat block of Pali district of Rajasthan was elaborately ap-

Table 4 : Chemical analysis of Representative Water Samples Collected from Rohat Block, Dist. Pali (Rajasthan)

S.No.	Parameter	VILLAGE						
		Gelawas	Mandawas	Bagria	Danasni	Diwandi	Dhloeria	Bandai
1.	EC(us/cm)	11/100	11/400	10/500	6/200	8/100	8/600	7/540
2.	TDS(mg/1)	7/215	7/410	6/825	4/030	5/265	5/600	4/910
3.	pH	7.95	8.20	8.15	8.20	8.20	8.10	7.45
4.	Na(mg/I)	1/805	1/852	1/710	1/007	1/320	1/397	1/225
5.	K(mg/l)	23	23	16	15	10	13.5	17
6.	Ca(mg/l)	432	445	410	240	315	336	295
7.	Mg(mg/I)	288	296	280	161	210	225	196
8.	CI (mg/l)	3/246	3/330	3/070	1/815	2/370	2/520	2/210
9.	So_4 (mg/l)	721	740	680	400	530	560	490
10.	Hco/3(mg/I)	725	750	695	415	550	565	510
11.	No/3 (mg/l)	25	28	26	25	30	31	37
12.	F (mg/l)	2.5	3.2	2.0	2.2	1.6	3.6	2.8

praised. Total area of Rohat Block is 1,378 sq km and it is drained by four important tributaries of Luni river namely Redia, Guhia, Bandi and Sukri. Luni river originates in the western slopes of the Aravali ranges at an elevation of 550 m near Ajmer. Water of river Luni is fresh (Potable) upto Balotra and becomes more and more saline further downstream. Total catchment of the river basin in the western Rajasthan is 38,273 sq.km covering the districts of Ajmer, Pali, Jodhpur, Nagaur, Barmer, Jalore and Sirohi. In Rohat block depth of ground water below the land surface is 5-8 m and thickness of alluvial formation is 30-45 m below the land. Electrical Conductivity near the river bank is 2 ds/m and away from river course is > 4 ds/m. Average yield of open wells is 150 to 200 cu m/day and of tube wells at the depth of 40-45 m is 15,000 to 20,000 lit per hour having an EC of 6-12 ds/m^2. The annual ground water recharge of Rohat block is 51.75 million cu m whereas, present withdrawal for irrigation is 5.3 million cu m. Thus 46.45 million cu m surplus ground water is available in Rohat block alone.

Table-5 : Ionic analysis of Ground Saline water and of Sea water

S.No.	*Parameter (mg/l)*	*Sea water*	*Saline water*
1.	Zinc	0.1	0.1
2.	Manganese	<0.01	<0.01
3.	Magnesium	1,068	882
4.	Iron	2.7	1.2
5.	Mercury	<0.001	<0.001
6.	Calcium	1,140	2,050
7.	Sodium	11,000	7,800
8.	Potassium	430	250
9.	Strontium	3.9	2.5
10.	Lithium	<0.01	<0.01
11.	Copper	0.04	0.02
12.	Aluminium	<0.01	<0.01
13.	Arsenic	<0.01	<0.01
14.	Lead	0.7	0.5
15.	Chromium	0.4	0.3
16.	Nickel	1.5	1.0
17.	Cadmium	<0.01	<0.01
18.	Chlorides	19,400	12,125
19.	Fluoride	1.6	1.5
20.	Bromide	Nil	Nil
21.	Iodide	Nil	Nil
22.	Molybdenum	<0.01	<0.01

Chemical Characteristics of Saline Water

The salinity of ground water found in various districts of Rajasthan is highly variable. It ranges from 0-2000 (s/cm to > 8,000 cm. The highest salinity of 45,000 (s/cm) is reported from Jaisalmer although Barmer is the leading district where most of the ground water is saline and unpotable. The prevalence of high salinity in ground water is mainly attributed to hydrological barriers like clayey formation and gypsum hardpans. These formations restrict the circulation of water through aquifers and extreme climatic conditions cause salanisation of ground water. The salinity of ground water is found high in western districts of Rajasthan followed by North-East and South-West districts. Another unique characteristic of these saline aquifers is increasing level of salinity with increasing depth. Hence, water of different salinities can be drawn from different depth levels. In Nawa and Kuchaman villages of Nagaur district the salinity of ground water was 30-35 ppt at upper depth but 50-100 ppt in deeper aquifers.

The other important characteristics of the ground saline water are hardness and fluoride content, though there is no correlation whatsoever between hardness and fluoride content on one hand and salinity on the other. The highest level of hardness is reported to be 3,810 mg/l (Dist.Bikaner) while that of fluoride is 90 mg/l (Dist. Nagaur) which are not considered to be favourable for aquaculture. But, such high levels are not encountered at every place. Representative water samples from few villages of Rohat block of district Pali were found to be suitable for brackishwater aquaculture (Table-4).

Ground Saline water *vs.* Sea water

In order to find out the variation in the ionic composition of ground saline water as compared to sea water, both the water samples were analysed (Table-5) for various cations and anions at Sri Ram Research Centre, New Delhi. Sea water sample (35ppt) was collected off Versowa (Andheri, Mumbai) coast and ground saline water (23 ppt) sample was taken from a deep tube well situated at brackishwater fish farm of CIFE, Rohtak Centre, district Rohtak, Haryana. For most of the components the ground saline water was found similar to sea water except for Magnesium, Calcium, Sodium and Chlorides. All these cations and anions increase the hardness of ground saline water which is a limiting factor for good growth of fish. However, the ionic composition of ground salinewater may be varying from place to place depending on various geographical, hydrological, climatic and sociological factors.

Use of Salt-affected Lands and Saline water Resources

Various State Agricultural Universities and several institutes under Indian Council of Agricultural Research, New Delhi, have developed remedial measures to improve salt affected soils and also to use them for agricultural purpose but their application has been very limited. Secondly, the extent of such areas is increasing every year. At few places the ground water of low salinity is used for crop irrigation. But, their regular use has an adverse effect on the productivity of soils. Hence, most of these resources are lying unutilised except for salt production at places where salinity is found high.

Salt production : India is one of the leading countries in salt production after USA and China. The total salt production of India was 144.53 lakh tonnes (Year 1999) against a target of 135 lakh tonnes (Govt.of India). The total area under salt cultivation in the country is 1.06 lakh ha. both in recognised and unrecognised sectors. Gujarat is the leading State in salt production contributing about 69.5% of total salt production of country. Out of this, 70.5% is produced from seawater and remaining 29.5% from inland ground salinewater. Tamilnadu is the second highest producer (14.9%) of salt followed by Rajasthan (11.9%). The total area un-

Table-6 : Candidate species suitable for farming in semi-arid and arid ecosytems

S. No	Species charcter	*Lates calcarifer*	*Chanos chanos*	*Mugil cephalus*	*Etroplus suratensis*	*Penaeus monodon*	*Macrobrachium rosenbergii*
1.	Salinity tolerance	0-40 ppt	0-40 ppt	0-40 ppt	0-40 ppt	0-40ppt	0-15 ppt
2.	Feeding habit	Carnivore	Herbivore	Herbivore	Herbivore	Omnivore	Omnivore
3.	Growth rate(g/yr)	500-1,000	1,000-3,300	1,000-1,200	200-250	150-250*	100-300*
4.	Production (t/ha/Yr)	2.0 -3.0	2..0-6.0	25.5-3.0	3.0-5.0	2.0-2.4*	1.5-3.0*
5.	Temperature tolerange (°C)	4-38	8-42	3-40	4-40	4-38	4-40
6.	Breeding in Hatchery	Yes	No	No	Yes	Yes	Yes
7.	Seed availability	Natural & Hatchery	Natural Collection	Natural collection	Natural & in Ponds	Hatchery	Hatchery
8.	Market Price (Rs/kg)	100-120	50-60	50-100	50-100	300-500	200-450

* *Six month culture period*

der salt production in Rajasthan is 2,550 ha. only. Nagaur, Jaipur, Ajmer, Sikar, Barmer, Jodhpur, Jaisalmer and Churu are salt producing districts in Rajasthan, maximum production being from Nagaur followed by Ajmer, Jodhpur and Jaipur. It is estimated that for producing one tonne of salt, 42,000 litres of brine of 35 ppt is needed.

Culture of Brackishwater Fin and Shell Fish

The culture of brackishwater fin and shell fish species viz., *Chanos chanos, Mugil cephalus, Lates calcarifer, Etroplus suratensis, Peneaus monodon*, and *P.indicus* (Table-6) is adopted on a commercial scale in most of the coastal states of India with high production levels . A large number of hatcheries are in operation to produce post-larvae of *P.monodon* all along the coast of India. Central Institute of Brackishwater Aquaculture, Chennai has developed the hatchery technology to produce the seed of *L.calcarifer*. The seed of *C.chanos* and *M.cephalus* is available through wild collection only, whereas seed of *E.suratensis* can be obtained from confined waters as the fish breeds under culture conditions. Central Institute of Fisheries Education, Mumbai is a pioneer in the use of ground saline water for brackishwater fish culture in Haryana (Dwivedi and Lingaraju, 1986). As a result of these trials it could be established that brackishwater fin and shell fish species could be cultured using ground saline water.

Brackishwater aquaculture in Rajasthan

S.N.Dwivedi, the then Director of Central Institute of Fisheries Education, Mumbai, conducted a survey of saline water regions of Rajasthan during 1983-'85 and as a result it was planned to set up a brackishwater fish culture unit at Jalore in 1986 but for some reasons it could not be established. Later in 1991 Central Institute of Brackishwater Aquaculture, Chennai again surveyed various sites in Rajasthan to test the suitability of ground saline water for aquaculture (Pillai and Chakraborti, 1992). Some of their important recommendations were:

1. Water qualities of the different sources vary considerably among themselves as well as those of brackishwater areas in the coastal States where brackishwater aquaculture is practised.
2. Soil of the surveyed sites are generally of lighter texture (sandy loam). The seepage loss of water would be very high. When ponds are formed, suitable measures should be taken to prevent seepage of water.
3. Brackishwater farming using saline water in inland areas would be complex. Experimental trials on the adaptability of shrimps and fishes to the new ecotopes are to be undertaken.
4. As per the exploratory studies of the ground water department the underground storage of water is much more than the annual recharge and hence sustained pumpage can be achieved even in drought years.
5. The high saline underground water available at the salt manufacturing sites may be suitable for culture of brine shrimp. However, further studies are required to assess the quality of these waters. Resident population of Artemia is available in Didwana lake and a proper culture technology could be developed for it.

Central Institute of Fisheries Education, Mumbai, in collaboration with Central Institute of Brackishwater Aquculture, Chennai, has initiated work on saline water aquaculture in Rajasthan under National Agricultural Technology Project of Indian Council of Agricultural Research, New Delhi. A Laboratory has been set up in the office of the State Department of Fisheries at Udaipur to monitor the progress of the project. Preliminary survey has been conducted to identify the potential sites for saline water aquaculture. Chemical characteristics of saline water indicates that it can be used for culture of fin and shell fish species viz., *Chanos chanos* (Milk fish), *Mugil cephalus* (Grey Mullet), *Lates calcarifer* (Sea bass/Bhetki), *Etroplus suratensis* (Pearl spot), *Peneaus monodon*, and *P.indicus* and also brine shrimp (*Artemia*) which holds very high market potential. The moderately saline water (upto 10 ppt) can be used for culture of giant freshwater prawn *Macrobrachium rosenbergii*. Experimental trials are in progress to study the survival and growth of *Mugil cephalus* and *M.rosenbergii* in two different ponds of 23 ppt and 7-8 ppt salinity each in district Bharatpur, Rajasthan. Both the species have survived well in both the ponds. Following this initial success both the ponds have been stocked with respective

species for commercial production during Oct-Nov,2001. There has been initial success which indicates that saline water resources of Rajasthan could be used for brackishwater aquaculture. Further experiments are in progress to develop an economically viable technological package for commercial application.

Limiting Factors to Brackishwater Aquaculture in Saline Water of Arid Regions

Availability of Seed of Brackishwater Fishes : Seed of brackishwater fishes and shrimps is available only in coastal states of India. The Post Larvae (PL) of shrimps viz; *Paeneus monodon* and *Peneaus indicus* which could be cultured in saline water were initially available through natural collection but during last few years a large number of commercial hatcheries have come up and the PL of shrimps are available almost through out the year. The seed of *Chanos chanos* is available along the coast of Tamil Nadu from March to May and again from July to August. In Orissa the seed is available from July to October and December to January. It is also available in Andhra Pradesh from March to June and again from September to December. The seed of *Etroplus suratensis* is available in Kerala, Karnataka and Goa almost through out the year with peak occurrence during August to September and November to January.

Arid Climate characteristics : The arid climate is characterised by low and erratic rainfall, extremes of minimum (4°C) and maximum (49°C) temperatures, low humidity and high rate of evapotranspiration. However, for saline water aquaculture rainfall has a very limited role to play but temperature and evapotranspiration are important factors. Annual potential evapotranspiration is 166.22 - 206.32 cm in the western part of Rajasthan, the highest being at Jaisalmer and the lowest at Ganganagar, whereas in eastern Rajasthan it varies from 138.12-174.52 cm, the lowest being at Udaipur and the highest in Jaipur. The high rate of evapotranspiration may be harmful for salinewater aquaculture as it may increase the salinity of pond water to intolerable limits. The continuous replenishment of pond water is also not advisable as it may lead to salt accumulation. Similarly, the low temperature during winter months may prove harmful to shrimps. However, high temperature will be helpful for better primary productivity of pond water. Therefore, it is very essential that methods are developed to reduce the harmful effects of low temperature and high rate of evapotranspiration.

Sandy soils : Soils in the salt affected regions with saline ground water have high content of sand which are highly permeable. In other words, the water seepage rate is very high in such soils. Maintaining the depth of water at desirable levels is very difficult and highly uneconomical. Hence, it is very essential to find out measures to control the seepage rate to take up saline water aquaculture. However, traditional methods making use of bentonite to control seepage of water in solar salt pans are available locally. Studies have to be conducted to find out if the same technology can be adopted for fish ponds.

Quality of saline water : Salinity of the ground water and also of surface water in most of the western Rajasthan is very high. Salinity requirement for brackishwater fish and shrimp culture is only 35-40 ppt. Hence, water of high salinity may not be of much use except for *Artemia* culture if it can be taken up successfully. Secondly, the hardness and fluoride content of saline water specifically in western Rajasthan is also reported be very high. It may further be a limiting factor for successful fish culture in saline water regions.

Environmental Impact : Brackishwater aquaculture using ground saline water will be a new activity for arid regions. An improper beginning may directly or indirectly lead to other environmental problems. First and foremost step could be continuous extraction of ground saline water to surface and its storage in ponds. Wrong methods of water extraction coupled with high seepage rate in ponds may contaminate the freshwater aquifers in upper ground layers. Secondly, the discharge of effluents from fish ponds may also cause environmental deterioration. Another aspect to be taken care of water-logged lands there will be the problem of drying up the ponds and this has to studied for a solution.

Acknowledgement

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References

1. ANNUAL REPORT (1999-2000), Salt Department, Ministry of Commerce and Industry, Govt. of India. 133 P.

2. DWIVEDI, S.N. and LINGARAJU, G.M. 1986. Strategy of prawn and fish culture in saline sub-soil waters of semi-arid zone of Haryana. Mahasagar, **19** (2) : 97-102.

3. Ground water Atlas of Rajasthan (World Bank (IDA) Aided Project) 1999. State Remote Sensing Application Centre (Department of Science and Technology), Govt. of Rajasthan, Jodhpur : 551

4. HOOJA, R., SRINIVAS, V. and Sharma, G. 1995. Waterlogging and salinity in IGNP, Rajasthan. In: Reclamation and management of water logged saline soils (Eds: RAO.K.V.G.K., AGGARWAL, M.C., SINGH, O.P. and OOSTERBANN, R.J). Publ:Central Soil Salinity Research Institute, Karnal and CCs Haryana Agricultural University, Hissar (Indo-Netheralnds collaborative project) : 141-159.

5. JOSHI, P.K. and TYAGI, N.K. 1994. Salt affected and water logged soils in India : A review. In ; Strategic change in Indian irrigation (Eds : Svendsen, M. and Gulati, A.). Publ : Indain Council of Agricultural Research, New Delhi and International Food Policy Research Institute, Washington, D.C. (USA).

6. PILLAI, S.M. and CHAKRABORTI, R.K. 1992. Report on the survey of brackishwater resources of Rajasthan for development of Aquaculture. Submitted to Govt. of Rajasthan (1992): 31 P.

Devi Sea Food's Shrimp/Scampi cooking Line

Inaugurated by Aquastar's Chief, Robert S. Hooey

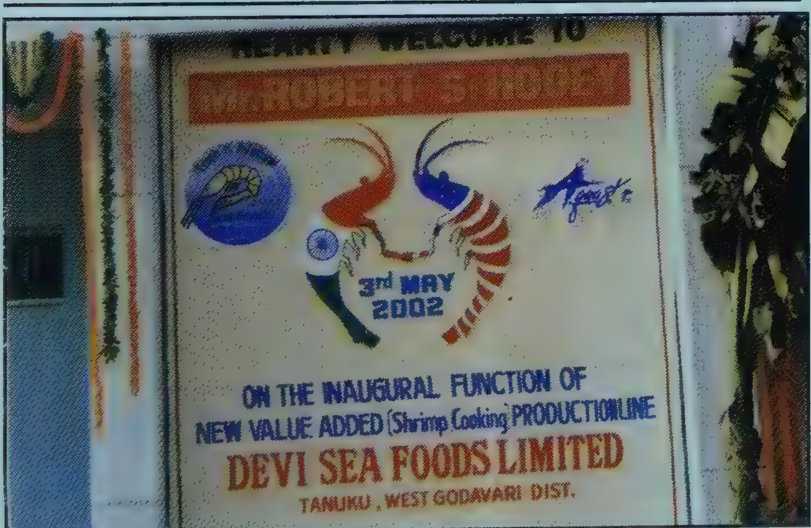
Tanuku, A.P : May 3, 2002

Robert S. Hooey, Chief of Aquastar Inc, Seattle, USA, inaugurated on 3 May 2002 a State of Art shrimp/scampi IQF cooking line at Devi sea foods processing plant located at Tanuku in West Godavari Dist of AP. Mr. Hooey availed of the occasion to strengthen Aquastar's association with Devi sea foods, a Visakhapatnam based company. The well laid line evoked an on-the-spot offer from the head of Aquastar to import the entire cooked produce (Black tiger shrimp and scampi) which Mr. P. Brahmanandam, Managing Director of Devi seafoods gracefully accepted. Brahmanandam said at the function that shrinking margins through export of raw shrimp as block frozen material led his comapny to instal the value-addition line, the only opening available to stay ahead of the competion.

Devi sea foods has two processing plants, one at Singarayakonda (production commenced in 1996) and another at Tanuku which started functioning in December 2000. Both the plants have HACCP regulatory compliance, having accreditation from USFDA. The plant at Tanuku has EU approval too. Both the plants have substantial freezing, cold storage, plate freezing, IQF tunnel freezing (Frigoseandia), and ice production capacities. The cooking line added to the Tanuku plant and inaugurated on 3rd May has a capacity of 500 kg/hr. A similar line is proposed to be installed at the company's plant at Singarayakonda. During 2000-01 the company exported 550.710 t of marine products worth over 23.6 million US dollars.

1. P. Brahmanandam escorting Robert S. Hooey to the Plant

2. Processing Plant of Devi Sea Foods at Tanuku, W.G. Dt., of A.P.



3. Banner welcoming Robert S. Hooey

4. Robert S. Hooey declaring open the IQF cooking line at the plant

5. A view of Processing Hall

6. IQF Cooking Line

7. Cooked shrimp line

8. Cooked Shrimp being chilled in counterflow chiller

9. Frozen Cooked IQF shrimp coming out of the Advantec Freezer

10. P. Brahmanandam, presenting the first pouch of cooked IQF shrimp to Robert S. Hooey. Krishna Rao looks on

11. Post-inauguration Meet : L to R ~ Robert S. Hooey, Krishnababu, Chairman, Devi Sea Foods, Y.T. Raju, M.L.A., M.H. Prasad, M. Shyam Prasad, Red Chamber India, K.A. John, Director, Devi Sea Foods

12. Another view of post-inauguration Meet

Strategies for Management of Karnataka Reservoirs

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Karnataka is endowed with rich freshwater reservoir resources comprising 74 reservoirs covering a waterspread of 2,23,887 ha. Including large tanks, the waterspread area increases to 4,37,291 ha and the state ranks third in India with regard to closed expansive waters (Sugunan, 1995), having enormous fishery potential. Though the potential of freshwater resources is impressive, the state lags behind in inland fish production (about 1.2 lakh tonnes in 1999-2000) as the yield potential of these water bodies has not been fully tapped due to lack of understanding of ecological principles and trophic dynamics coupled with improper management. Fisheries development in reservoirs is environmental friendly, labour intensive, and generates employment opportunities to the poorest of the poor, thereby promoting rural economy. Thus, before formulating management measures, certain studies related to their yield potential, availablity of fish food resources and relationship amongst different niches need to be undertaken in detail. In this context, the present study, aimed at formulating some plausible management guidelines for the sustainable developoment of fisheries in some selected reservoirs of Karnataka under three riverine systems, has been undertaken.

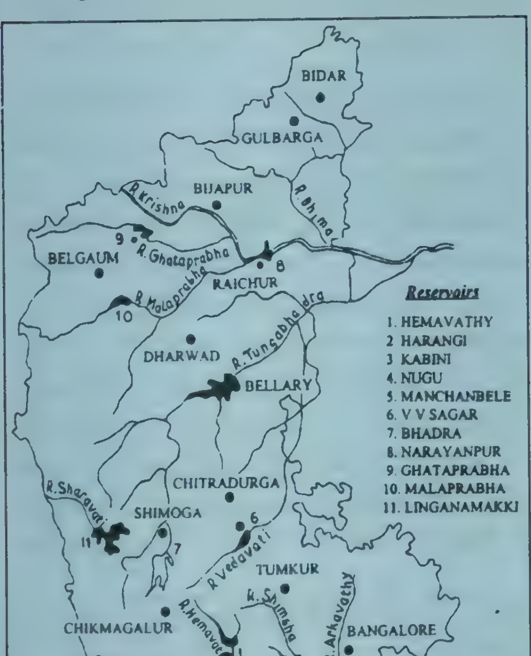

Fig 1. Map of Karnataka showing the location of Reservoirs

Reservoirs Studied : Eleven reservoirs viz., Hemavathy, Harangi, Kabini, Nugu, Machanbele under Cauvery river system, Vani Vilas Sagar(VVSagar), Narayanpur, Ghataprabha and Malapraba under Krishna river system and Linganamakki from the West flowing Sharavathy river have been selected for limnological studies during 1995-97 for evolving management measures for augmenting fish production in these water bodies. Among the Cauvery basin reservoirs (CB reservoirs), expect Manchanbele (on river Arkavathy, the eastern most tributary), others are on the respective tributaries originating in Western ghats. In the case of Krishna basin reservoirs (KB reservoirs), Bhadra (formed on river Bhadra), VVSagar(formed on river Vedavathy) belong to Tungabhadra drain. Ghataprabha and Malaprabha are formed on the tributaries, while Nagarayapur is formed on the main stream of river Krishna(fig.1).

Morphometric and Hydrographic Features **:** Salient morphometic and hydrographic features of these reservoirs have been projected in Table 1. CB reservoirs are at lower latitudes (11° 58' & 12° 52'N) and higher elevations(755.9 to 890.6 m asl) as compared to KB reservoirs which are at relatively higher latitudes (13° 42' & 16° 15'N) and lower elevations (492.2 to 633.8 m asl). Liganamakki is the largest (waterspread 31,728 ha, and Manchanbele is the smallest one with an area of 329 ha. VV Sagar, the oldest one, was formed in 1901, while Manchanbele is a new inpoundment filled in 1991. The ratio of catchment to reservoir (C/A) area at FRL, an index of allochthonous load into the reservoir, is very high in Manchanbele and the lowest in Linganamakki. The mean depth, a basic productivity factor, is the highest in Bhadra (21.1m) and the lowest in Malaprabha (7.9 m). The flushing rate (annual inflow/Storage capacity) is very high in Narayanpur (21.4) and very low in VVSagar (0.17). In general, CB reservoirs have the highest flushing rate compared to others. High C/A with moderate flushing rate has a greater bearing on productivity.

Catchment Ecology **:** All the reservoirs are situated in high rainfall (100-200 cm) zone of Western ghats. Barring Manchanbele, VVSagar and Narayanpur, most of the reservoirs have uninterrupted extensive catchment. The rainfall decreases from west to east. Temperature fluctuates between 16 and 34° c. Maximum precipitation occurs during May to October, with peak in June-July. Red and lateritic soils predominate in the catchment. Hemavathy and Bhadra originate from Chikmagalur district, the catchment of which is mostly hilly with forest cover including cultivated land. Clayloam to sandy-clay-loam is the soil texture. River Vedavathi arises in Bababudangiri hills having 62-84 cm rainfall with peak in September. Land is under rainfed cultivation in as-

sociation with moderate dense forest cover. Narayanpur catchment comprises hills and undulating plains with predominance of black soil, while annual precipitation ranges from 68-80 cm. Ghataprabha rises in the hills of Sahyadri having 44-285 cm precipitation with prerdominance of red-gravely soil covered by forest, grass and cultivated land, while catchment of Malaprabha is situated in the transitional precipitation belt (153-470 cm) of the leeward side of Western Ghats, major portion of which is under cultivation.

Salient Environmental Characteristics of Sediment and Water **:** Basin texture remained predominantly sandy in most of the reservoirs. In CB reservoirs soil reaction was acidic with pH in the range 4.0 (Harangi) to 5.8 (Hemavathy). It was acidic (pH 5.3) in Linganamakki also. While in KB reservoirs, it was slightly acidic in Bhadra & Ghataprabha, neutral in Narayanpur and Malaprabha, it was alkaline in VVSagar (pH 8.1). Fairly rich organic carbon content was noticed in almost all the reservoirs ranging from 0.7 (Narayanpur) to 2.7% (Harangi). It was more than 1.5% in all the reservoirs except Narayanpur and Malaprabha which is considered to be optimal for fish production. Decomposition rate of bottom organic matter was low due to acidic nature of soil especially in all the CB reservoirs and Ghataprabha and Bhadra under KB reservoirs, getting reflected in high C/N ratio of their sediment (Das and Krishna Rao, 1999). High C/N ratio in VVSagar also was due to macrophytic load.

Water temperature varied from 24.3 (Ghataprabha) to 27°c (Linganamakki) in the overall range of 22.2 to 32.0°c with narrow seasonal fluctuations (3-7°c) due to low latitude(11°58' to 16°15' (N). Turbidity was very low in most of the reservoirs. Secchi depth ranged from 0.9 (Nagu) to 3.2 m (Bhadra). In monsoon, it was the lowest in Ghataprabha (0.1 m) and the highest in Bhadra (2.0 m). Water pH was neutral to alkaline. During summer, water pH reached over 8.90 in Narayanpur, Nagu and Malaprabha (Table 2). Surface waters were well oxygenated with dissolved oxygen (DO) around 7.0 mg/l but showed difference in oxygen content with increasing depth in varying degrees. On most occasions, free CO_2 was noticed in surface waters in the range 1 to 6 mg/l. CB reservoirs had lower values of total alkalinity (TA) at 26-48 mg/l barring Manchanbele (144 mg/l) as compared to KB reservoirs; it was the lowest in Bhadra (31 mg/l) and the highest in VVSagar (207 mg/l). TA was the lowest in Linganamakki (20 mg/l) amongst all the reservoirs investigated. Among CB reservoirs, specific conductance was low in Kabini and the highest in Manchanbele. VVSagar recorded the highest value (647 μ/S/cm) and Linganamakki had the lowest concentration of ions (57 μ/S/cm), amongst all the reservoirs.

Harangi, Manchanbele and Bhadra reservoirs showed thermoclinity,with clear demarcation of epi-and metalimnion. Oxygen profile was orthograde in Ghataprabha, Malaprabha, Narayanpur and Bhadra and clinograde in Harangi, Manchanbele, Nugu, VVSagar and LInganamakki.

The strength of oxycline in water column especially during pre-monsoon dictates operation of gillnets restricting it to top few metres, as the fish is confined only to the epilimnetic zone as observed in Manchanbele.

Among dissolved nutrients, nitrate and phosphate have been widely studied and their role in aquatic productivity has been well recorded. As a constituent of protein, nitrogen occupies an important place in aquatic ecosystem. A concentration of 0.2 to 0.5 mg/l of inorganic nitrogen and 0.05 to 0.2 mg/l of phosphorus have been considered to be favourable for medium to high levels of productivity. The nutrient status of reservoirs (Das and Krishna Rao, 1999) covered under this study is of a low order with nitrate nitrogen in the range of 0.03 (Narayanpur) to 0.14 mg/l (Harangi) and phosphate between 0.01 (Harangi) and 0.03 mg/l (V V Sagar. Relatively higher values were recorded during post-monsoon months and low values in pre-monsoon months. It is interesting to note that in spite of dense submerged aquatic vegetation in VVSagar, phosphate levels remained high as compared to other reservoirs.

Production potential : Gross production (P) and community respiration (R) for different reservoirs are depicted in Fig.2. Gross production was maximum during monsoon in Hemavathy, Kabini, Manchanbele, Bhadra and Linganamakki, whereas Nugu and Ghataprabha recorded maximum production in pre-monsoon. The seasonal variation was wide in the case of Kabini, Manchanbele, Bhadra and Linganamakki (the ratio of maximum to minimum was 3.7 to 4.1), whereas the same was negligible in Harangi (ratio : 1.1). Thus, primary production of Manchanbele and Narayanpur is in the higher range, that of Ghataprabha and Malaprabha in the lower range and that of the rest of the reservoirs in the medium range.

Even in the best managed Indian reservoirs fish yield levels never exceeded 0.2% of gross primary production (GP) (Natarajan,1979). Thus, a judicial consideration of 0.2% GP as well as catchment characteristics of an individual reservoir, the potential fish yield (PFY) (kg/ha/yr) has been estimated at 50-60 kg in Hemavathy, 60-75 kg in Harangi, 50-70 kg in Kabini, 80-100 kg in Nugu, 170-180 kg in Manchanbele, 30-40 kg in Bhadra, 60-70 kg in VVSagar, 100-

Status of productivity	*Yield (kg/ha)*	*Reservoir*
High	100-150	Manchanbele, Narayanpu
Medium	50-100	Nugu, Kabini, Harangi, VVSagar, Hemavathy
Low	30-50	Malaprabha, Bhadra, Ghataprabha, Linganamakki

Table 1. Location, morphometry and hydrology of Karnataka reservoirs

	Cauvery					Krishna					Sharavathy
Reservoirs	Hemavathy	Harangi	Kabini	Nugu	M.bele	VV Sagar	Bhadra	N.pur	G.prabha	M.prabha	L.makki
River	Hemavathy	Harangi	Kabini	Nugu	Arkavathy	Vedavathy	Bhadra	Krishna	G.prabha	M.prabha	Sharavathy
Latitude (N)	12°40'	12°29'	11°58'	11°58'	12°52'	13°51'	13°42'	16°10'	16°15'	15°45'	14°10'
Elevation (m asl)	890.6	871.4	755.9	762.0	736.1	621.0	619.7	492.2	662.9	633.8	555
Year of Construction	1979	1984	1974	1958	1991	1901	1963	1982	1977	1974	1964
Catchment (C) (km^2)	2800	419	2142	984	1590	5374	1968	47850	1412	2176	1992
Reservoir area (A) (ha)	8502	1909	6060	1398	329	8759	11250	13200	6837	13578	31728
C/A ratio	.33	22	35	70	435	61	17	362	21	16	6
Capacity (10^6 m^3)	1050.6	240.7	552.7	154.1	31.4	840.7	2023	1066	1443	1068	4435
Max.depth (m)	40.2	47.2	-	-	24.4	41.4	54.9	22.3	53.4	40.2	52
Mean depth (m)	12.4	12.6	9.1	11	9.5	8.6	18.0	8.1	21.1	7.9	13.6
Total inflow ($10^6 m^3$)	3646	1113	-	283	36.6	145	2324	22824	2147	-	5867
Flushing rate	3.47	4.62	-	1.84	1.17	0.17	1.15	21.4	1.48	-	1.32
Volume development	0.92	0.86	-	-	1.17	0.62	0.98	1.09	1.19	0.59	0.78

Table 2. Chemical characteristics of soil and water of Karnataka reservoirs (range & average)

Parameter / Reservoirs	Sediment				Water					
	pH	Org C (%)	Total N (%)	C/N ratio	Temp. (°C)	Trans. (m)	DO (mg/l)	pH	TA (mg/l)	Sp.cond (µS/cm)
Hemavathy	5.8	1.8	0.07	28	24.8	1.6	7.6	7.7	48	147
	5.6-6.0	1.5-2.0	0.05-0.08	22.1-37.8	22.5-27.5	0.5-2.2	7.0-7.6	7.3-8.3	29-78	100-200
Harangi	4.9	2.7	0.1	26	25.3	1.7	7.6	7.4	35	97
	4.8-5.0	2.3-2.9	0.09-0.12	23.8-29.0	22.4-28.5	1.5-1.9	7.3-7.8	7.1-8.0	16-68	90-100
Kabini	5.0	1.9	0.07	25	27.5	1.6	6.9	7.5	25	90
	4.9-5.2	1.3-2.4	0.06-0.08	21.3-29.6	24.6-32.0	1.0-2.0	6.6-7.2	7.0-7.8	20-36	60-110
Nugu	5.5	1.7	0.09	20	27.4	0.9	7.3	8.1	40	120
	5.0-6.3	1.5-1.9	0.07-0.10	15.9-23.2	25.2-30.0	0.4-1.2	7.0-7.8	7.5-8.8	28-48	100-140
Manchanbele	6.5	1.8	0.09	22	27.3	0.9	7.3	8.5	144	403
	6.4-6.5	1.1-2.4	0.06-0.12	17.0-30.1	26.0-29.5	0.7-1.0	7.1-7.6	8.3-8.7	138-148	390-420
Narayanpur	7.2	0.7	0.05	14	25.8	1.1	7.6	8.3	154	457
	6.9-7.5	0.6-0.8	0.04-0.07	11.4-15.0	23.2-27.8	1.0-1.2	7.5-7.7	7.8-8.8	148-160	440-480
Ghataprabha	5.8	2.0	0.07	30	24.3	1.5	6.9	8.2	32	100
	5.6-6.3	1.3-2.5	0.05-0.08	26.0-35.0	22.2-27.5	0.1-3.3	6.6-7.2	7.8-8.5	24-40	70-150
Malaprabha	6.5	0.9	0.08	12	25.0	1.3	7.2	8.4	79	203
	6.4-6.7	0.8-1.2	0.06-0.09	10.0-13.3	22.5-27.6	1.0-1.5	6.8-7.7	8.1-8.7	56-92	120-270
Bhadra	5.5	2.2	0.08	28	26.9	3.2	7.8	7.5	31	117
	5.3-5.6	2.0-2.4	0.07-0.09	25.0-31.0	25.2-28.3	2.0-4.0	7.2-8.4	7.3-7.7	18-48	100-130
VVSagar	8.1	1.9	0.09	22	26.2	1.2	6.7	8.2	207	647
	8.1-8.2	1.8-2.0	0.07-0.10	19.2-25.3	25.0-26.8	1.0-1.5	6.4-7.0	7.9-8.4	200-210	550-730
Linganamakki	5.3	2.0	0.07	27	27.9	1.5	6.9	7.1	21	57
	4.6-6.1	1.1-3.4	0.06-0.09	17.1-34.4	26.1-30.0	0.4-2.3	6.5-7.3	6.7-7.6	14-28	40-80

130 kg in Narayanpur, 30-40 kg in Ghataprabha, 30-40 kg in Malaprabha and 30-40 kg in Linganamakki.

Considering all the productive characteristiccs, the yield potential of different reservoirs could be summarised as below.

Plausible Guidelines for Management

The indigenous fish stock levels of Cauvery and Krishna river systems are not adequate to realise the yield potential of the reservoirs. Hence, it is absolutely necessary to stock major carps to maximise production at a sustainable level. However, there are apprehensions that Gangetic major carps are inimical to native species, though such misgivings appear to be based on insufficient information. The objectives of stocking, besides aiming at maximising yield, should also cover preservation of the boidiversity of the system. In general, tributaries (being seasonal) harbour few species of commercial importance and hence, addition of new species is likely to improve the species diversity in them as against the main river. The problem of preserving biodiversity should primarily be tackled in the mainstream reservoirs. In the present investigation, barring Narayanpur, all the reservoirs are on tributaries.

As per the records of the Fisheries Department of Karnataka, stocking of major carps and common carp has been done in varying degree in all the reservoirs, barring Narayanpur and Manchanbele. Stocking appears to be judicious and the species consisted predominantly of common carp followed by rohu and catla. Scant attention has been paid regarding the suitability of the species stocked and needs of the reservoir concerned. There is no agency monitoring the catch. In the absence of reliable data on catch and catch composition from any reservoir, no effort has been made to assess the impact of stocking. Sporadic occurrence of common carp and major carps has been recorded in the catches. The present yield of reservoirs appears to be very low and is only a fraction of the potential. A judicious stocking and exploitation policy is called for to realise the potential.

Catla sould be stocked in all the reservoirs. It should form the dominant component stocked, except in VVSagar, Bhadra and Hemavathy. The performance of rohu in reservoirs, in general, has not been very encouraging especially in oligotrophic ones. The growth of rohu has been impressive in old reservoirs with rich periphytic flora and fauna. A limited presence of aquatic vegetation is particularly suitable for the growth of the species. It may not do well in VV sagar. Hence, rohu should form the dominant component of stocking in VV sagar and next to catla in Nugu, Kabini, Hemavathy, Narayanpur and Linganamakki. Mrigal should be given adequate representation, especially in Ghataprabha, Malaprabha, Harangi, Linganamakki and Bhadra. Common carp may be stocked in VV sagar, Hemavathy, Kabini, Harangi and Malaprabha. Stocking of this species should be avoided in reservoirs having large catfishes and with poor bottom fauna.

The Deccan mahseer, *Tor khudree*, is an important sport fish of peninsular rivers. It has been subjected to increasing environmental stresses due to a combination of factors like reservoir formation, heavy exploitation and wanton destruction of the habitat. The need to conserve and propagate the species has been recognised in the State. A mahseer hatchery is being established near Harangi reservoir. When it becomes operational, mahseer seed will be available for stocking the reservoirs. Suitable reservoirs for the species are Harangi, Kabini, Nugu and Bhadra.

Stocking of grass carp in VV sagar should be considered in order to utilise the submerged aquatic vegetation. No other species is as affective as grass carp in checking the spread of vegetation in water bodies. The species may not pose any threat to indigenous species and is not likely to propagate in the reservoir. Controlling aquatic vegetation with grass carp will not only add to the productivity but will also reduce the silting of the reservoir.

The length of fish seed at the time of stocking is critical in a reservoir ecosystem to enhance thier survival. A length of 10 cm and above is ideal for quick growth and better survival. About 200-300 fingerlings per hectare may be stocked in large reservoirs and 300-400 fingerlings in medium and small reservoirs. Average area [(FRL+DSL)/2] or 60% of the full reservoir area may be considered for computing the stocking.

Stocking should be done preferably during post - monsoon (Sep-Oct), when the water level stabilises and a spurt in zooplankton production occurs. Common carp may be stocked in pre-monsoon months.

Natural breeding and recruitment of stocked species varies from reservoir to reservoir. Breeding is no guarantee for successful recruitment, as survival depends on many factors. In general, natural recruitment is not dependable in reservoirs, especially in those formed on tributaries, which warrants stocking on a continuing basis.

Once the fishery is established, fishermen should be rehabilitated around a reservoir at suitable settlements. At present the community migrate from reservoir to reservoir with their families living in temporary settlements under trying conditions. The children also migrate with them and participate in the actvities connected with fishing and marketing. A permanent settlement is a must to allow the children to attend school and to have other childhood activities.

Though there is a system of mesh regulation, it is not generally enforced. Strict mesh regulation should be enforced to prevent exploitation of small sized species. Small-meshed nets could, however, be operated in certain seasons and in certain areas to exploit the minor carps and minnows under supervision. The best season for such operation would be the period of low water levels. Seed

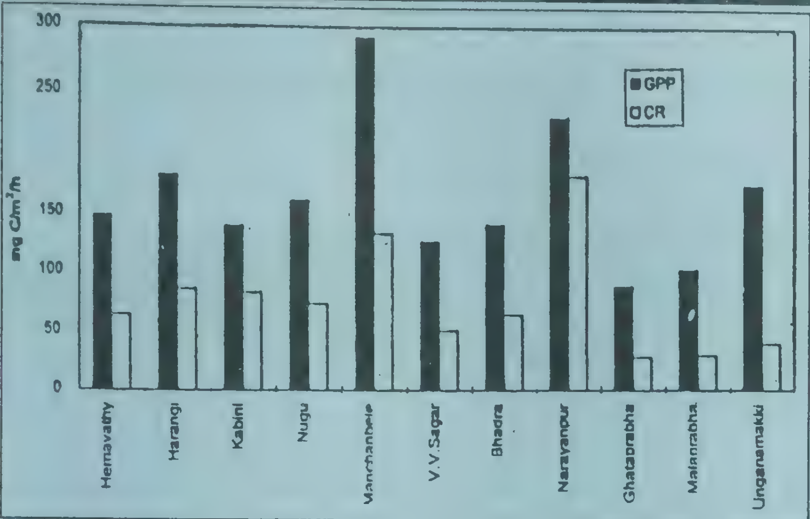

Fig 2. Gross production (GRP) and community respiration (CR) in Karnataka reservoirs

rearing farms have been constructed at most of the reservoirs. However, many of them have become non-functional. The functional ones at Bhadra and Kabini cater to the needs of smaller water bodies in the area. It is necessary to strengthen infrastructural facilities for stocking and exploitation of each of the reservoirs.

At present licences are issued by the department to fishermen for explotation. It is desirable that the existing cooperative societies are activated and reservoir fisheries are leased out to the society of the area for management. The fishermen should also be made partners in the management.

Data on such aspects as species-wise fish landings, fishing effort and details of stocking should be collected so as to create a database for each of the reservoirs as it is an essential prerequisite for reservoir fisheries development.

Reservoirs of Karnataka have been sanctuaries for some species of *Puntius*. In recent years there has been some decline of these species owing to periodic recruitment failure and competition from stocked carps. Steps should be taken at rehabilitation of these species to their earlier levels. Seed production of indigenous carps such as *L. fimbriatus, P. jerdoni, P. carnaticus* and *C. cirrhosa* should be undertaken to preserve the biodiversity of these peninsular rivers.

New systems of culture, such as pen and cage culture should be introduced to utilise the potential of reservoirs comprehensively to get enhanced fish production; pen culture may be introduced to raise fish seed and cage culture for raising table fish. Pen culture is suitable in reservoirs which have shallow bays and get filled up early in the season (July/Aug) and retain that level for 2 to 3 months (Oct-Nov). Reservoirs suitable for pen culture are : Kabini, Hemavathy and Narayanpur. Cage culture is suitable for all reservoirs. It is worthwhile giving ownership of cages to individual fish farmers with financial help from NGOs and commercial banks. This will bring additional income to fishermen.

Tilapia (*O.mossmabicus)*has been recorded in several reservoirs. It may not get established in the long run due to water level fluctuations and presence of predatory fishes. Absence of predatory fishes and lack of competition from other species in Manchanbele reservoir have offered congenial environment for the proliferation of tilapia where it has established itself firmly as a dominant fishery. The species should be controlled as there is every likelihood of it entering the main river affecting endemic fish fauna.

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References

DAS. K.K. & KRISHNA RAO. D.S.1999 Nutrient regime in Karnataka reservoirs. IN : Proc.National Seminar on *Eco-firendly Management of Resrources for Doubling Fish Production - strategies for 21st century,* Inland Fish. Soc. India and CIFRI., Barrackpore, 22-23 December 1999.

NATARAJAN. A.V.1979. Ecosystem oriented approach for fisheries development in India. Souvenir on the ICAR golden jubilee year, CIFRI, Barrackpore, India, Part I : 107-111.

SUGUNAN. V.V.1995. Reservoir Fisheries of India. FAO fisheries Technical paper, 345, Rome.

NFF demands withdrawal of Aquaculture Authority Bill

The National Fishworker's Forum (NFF) has demanded the withdrawal of Aquaculture Authority Bill and wanted the Supreme Court's judgement on Coastal Regulatory Zone (CRZ) to be implemented without any dilution to ensure traditional and customary rights of fishermen.

The NFF Chairperson, Harikrishna Debnath, is leading a jeep jatra along the Coast from West Bengal to Thriuvanthapuram demanding implementation of their charter of 42 demands including 21 recommendations of the Murari Committee. Another jatra along the West Coast is being led by Thomas Kocherry. The two will converge in Trivandrum and hold a massive rally on July 14.

Mr.Debnath is reported to have said that the demands would be submitted to the Government at Thiruvanthapuram giving it 70 days time to act upon them and if there is no response after July 25, fishermen would resort to agitation.

Debanth alleged that, in violation of the recommednations of Murari Committee licences of four companies were extended and new permits given to 21 companies.

He said the situation worsened with lifting of curbs on import of fishing vessels and fishing equipments. Taking advantage of it, foreign agencies were fishing by proxy in the name of deferred payment. The violation came to light following the seizure of three vessels by the Coast Gaurd. Debnath also took exception to the processed fish imports which stood at nearly 5,000 tonnes last year.

To deal effectively wiht the problems relating to fishing, a separate ministry of Fisheries should be created. Debnath demanded. At present, depending on the nature of activity, fishing was being dealt with by the Departments of Agriculture, Food processing and Commerce, he said.

Radiation processing for the control of biohazards in aquaculture

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As compared with capture fisheries, aquacultured fish and shellfish are closer to biological and chemical hazards due to possibilities of their contamination through agents from both freshwater and coastal ecosystems. The biological hazards include parasites, insects, pathogenic microorganisms and viruses. Consumers in several Asian countries have the habit of eating raw or partially cooked fishery items. Therefore, with enhanced export potential of several aquacultured species there is need for implementation of HACCP concept along with newer processing techniques in order to protect the consumers against the hazards. The safety issues associated with aquarcultured products have been recently highlighted by a Joint FAO/NACA/WHO Study Group. Exposure of foods to ionizing radiation is an emerging technology to improve the hygiene of a variety of food products, both of argicultural as well as animal origin. This contribution is intended to briefly discuss the various biological hazards associated with aquaculture operations and the scope of using ionizing radiation in countering of the problems. The recent Gazette notification by the Government of India permitting irradiation of fishery products could be a boon for the improvement of quality of aquacultured fish and shellfish both for domestic consumption as well as export.

Biohazards and safety issues in aquaculture

Zoonoses **:** A large number of fish species, both marine and freshwater, are potential sources of important parasitic zoonoses. Some of these zoonoses are highly pathogenic. The principal human diseases are trematodiasis, nematodiasis and cetodiasis, which are caused by consumption of raw or uncooked fish. Fish-borne trematodiases are importrant diseases in various parts of the world, causing morbidity and complications leading to death. The cause of infection is the ingestion of viable encysted trematode metacercariae, which can be present in the flesh of raw, inadequately cooked or minimally processed freshwater fish. The two major genera of importance for human health are *Clonorchis and Opisthorchis.* Clonorchiasis, caused by *Clonorchis* is endemic in some countries of East Asia. The larvae of *C.sinenis* multiplies in snails and the released free swimming cercariae penetrate and form cysts in fresh or dried fish muscle, where it can persist for a considerable time. When ingested by humans, the clonorchis metacercariae migrate to the bile duct, through small intestine where they cause clinical disease. The meta cercariae can be killed by adequate cooking.

Marine mamals, birds and pig are natural definitive hosts for nematodiases whose second intermediate hosts are fish of diverse origin. Capillariasis caused by *Capillaria philippinensis* results in gastroenteritis and this is due to eating of raw small freshwater fish infested with the nematode. Similarly, consumption of raw, inadequately cooked or partially processed fish such as catfish, eels, carp and snakeheads is the main reason for gnathostomaisis caused by *Gnathostoma spinigerum.* Many aquacultured fishes harbour *G. spinigerum.*

Anisakiasis in humans is caused by *Anisakis simplex* due to the consumption of infected raw marine fish and cephalopods. In Japan about 3000 cases of anisakiasis are reported annually. Many countries now insist that fish used for mildly processed products be frozen before processing or sale, although cooking and freezing may not protect against allergic reactions to ingested *A.simplex* antigens. Diphyllobothriasis is the most major human cestodiasis, which is caused by the consumption of marine or freshwater fish infected with the tapeworm *Diphyllobothrium latum,* found mainly in cold waters. Salmon has been recognised as an important carrier of the parasite. Other parasites such as *Taxoplasma, Trichinella*, which are more prevalent in red meat, are not usually encountered in fishery items.

Bacterial pathogens

The human pathogenic bacteria which may be present in aquacultured finfish and crustaceans include *Enterdbacteriao, Vibrio* spp., *Aeromonas and plesiomonas* spp., *Clostridium botulinum*, and *Listeria monocytogenes.* Significant numbers of organisms belonging to Enterobacteriaceae have been found in products harvested form waste-fed systems, and such products therefore pose a potential health risk. *Salmonella* spp. are among the most important causes of human gastrointestinal disease worldwide and many seafood-importing countries do not permit the presence of the organism in imported consignments. The organisms have been reported in fish ponds, which are usually scavenged by birds. *Salmonella* spp. have also been detected in the gut of aquacultured tilapia and carp. Where animal manure, particularly bovine manure, is used as pond fertilizer, there is a risk that pathogenic strains of *Escherichia coli* (*E. coli* 0157: H7) may be present in pond water. Other pathogenic bacteria, including

Table 1. Salient features of radiation processing of fishery products

- Radiation treatment is low energy process.
- The treatment is a cold process since no rise in temperature of the product occurs.
- Cost effective process. The radiation sources, namely cobalt-60, caesium-137 and electron beams are available.
- Irradiation causes fewer overall physical and sensory changes than cooking, freezing or canning.
- Irradiation is a physical process and hence no external residues in the treated foods.
- High penetration power of the radiation can eliminate non-spore forming pathogenic bacteria and parasites even from the interior parts of fish.
- Ready-to-export frozen blocks of seafoods can be treated prior to shipment.
- Radiation pasteurization of chilled fish and shellfish helps in significant extension of shelf life by inactivation of spoilage-causing microorganisms.
- Accepted by several international bodies such as WHO,FAO,Codex Alimentarius Commission, US FDA etc.

Shigella spp., have also been isolated in aquacultured systems. Poultry guts invariably harbour *Campylobacter* spp. and hence use of poultry-based manure may poses hazards in inland and coastal aquacultured fish. However, the risk associated with consumption of aquacultured fish infested with this bacterium is rather low.

Vibrio spp. being salt tolerant, occur in marine and brackishwaters, while *V.cholerae* and *V.mimicus* also occur in freshwater. Some *Vibrio* spp. are both human and fish pathogens. While cholera has been associated with the consumption of raw fishery products, there are no reported cases resulting from the consumption of commercially imported farmed finfish and curstaceans. *V.parahaemolyticus* has been a major cause of gastroenteritis and is partucularly associated with the consumption of raw marine crustaceans and fish. *Aeromonas hydrophila* is associated with food-borne disease and *Plesiomonas* spp. has been implicated in outbreaks of gastroenteritis from fish consumption. *Clostridium botulinum* type E is naturally found in aquatic environments and is often isolated from fish. Another pathogen, *Listeria monocytogenes* is frequently reported from aquaculture products from temperate regions, but is rarely reported in tropical fishery products.

Other Hazards

White spot disease caused by viral contamination has been a major reason for the setback in shrimp aquaculture for the last few years. The disease is spread

Table 2. Frequently asked questions on Radiation Processing of Food

Q1. Does radiation processing makes food radioactive?

A. No. The radiation processing involves passing food through a radiation field but the food itself never comes in contact with the radioactive substance. Gamma rays, X-rays and electrons used do not induce any radioactivity in foods.

Q2. Is radiation-processed food safe for consumption?

A. Yes. Extensive scientific studies have shown that radiation processed food is safe for human consumption. Long term feeding studies with various animals as well as detailed investigation on the chemical changes have shown that there are no toxicological hazards to humans.

Q3. Does radiation processing affect the nutritional value of food?

A. No. In camparison to other food processing and preservation methods the nutritional value is least affected by radiation processing. The treatment has very little effect on the main nutrients such as proteins, carbohydrates, fats and minerals. Vitamins show varied sensitivity to food processing methods including radiation. For example, vitamin C and B_1 (Thiamine) are equally sensitive to radiation as well as heat processing. Vitamin A,E,C,K and B_1 in food are relatively sensitive to radiation, while riboflavin, niacin and vitamin D are much more stable. The Joint Expert Committee of the Food and Agriculture Organization (FAO), World Health Organization (WHO) and International Atomic Energy Agency (IAEA), in 1980 concluded that radiation processing does not induce any special nutritional problems in food.

Q4. What are the chemical changes in radiation processed foods and are they harmful?

A. Radiation processing produces very little chemical changes in food. None of the changes known to occur have been found to be harmful. The radiolytic products and free radicals produced are identical to those present in foods subject to treatment such as cooking, canning etc. Highly sensitive scientific tests carried out during the past 35 years have failed to detect any new chemical product in radiation processed foods.

Q5. How can radiation processed foods be identified in the market?

A. Radiation processed food cannot be recognized by sight,smell, taste or touch. Codex Alimentarius Commission has endorsed a green irradiation logo. As per the PFA (Fifth Amendment) Rules, 1994, all packages of radiation processed foods to be marketed in India will be labelled with this logo, along with the words "Processed by irradiation method", and the date of irradiation, license number of the facility and the purpose of irradiation. Consumers will have a free choice to buy radiation processed or non-radiation processed commodity.

Table 3. Public concerns regarding safety of radiation processed seafoods.

Q1. Can radiation processing be used to make spoiled fish food, or to clean up "Dirty Fish"?

A. No. Like any other food treatment irradiation cannot reverse the spoilage process and make bad fish good. A fish that looks, smell and tastes bad cannot be saved by any treatment including radiation processing.

Q2. Can radiation processing by used to destroy microbial toxins and pathogenic viruses in fish?

A. No. As in many other food processing procedures only food of good hygienic quality should be irradiated. It is very important that foods intended for processing are of good quality and handled and prepared according to good manufacturing practices(GMP) established by national and international standards.

Q3. If *Staphylococcus aureus* has grown in fish producing enterotoxin, can the fish be treated with radiation and sold?

A. No. If *S.aureus* has already grown in fish and produced toxin due to mishandling, the fish will be spoiled due to the growth of spoilage organisms. Such spoiled fish cannot to treated with radiation. Further radiation processing does not destroy preformed toxin; in fact, the food needs to be treated allowing growth of bacteria.

Q4. How radiation processing is controlled to ensure that foods are properly treated?

A. The construction and operation of a food irradiation facility for commercial purpose is governed by the Prevention of Food Adulteration Act, 1954 and Rules, 1955 and the Atomic Energy (Control of Irradiation of Food) Rules 1996, under the Atomic Energy Act, 1962. Each food item and the dose needed to treat it for a specific purpose is cleared by the Central Committee for Food Standards(CCFS) and the food items approved for radiation processing are notified in the Gazette of India as an amendment of PFA. Operators are specially trained for the Food Irradiation Facility and Quality Control Officer ensures that only good quality foods manufactured using GMP are treated with the recommended dose. The processed food is labelled and all the records regarding dosimetry and radiation processing are maintained.

mostly through infected post-lawae of shrimps. Consumption of raw molluscan bivalves is a major cause of viral disease associated with aquatic animals. A large number of toxic compounds produced by aquatic algae and detrital bacteria, which serve as food for the larvae of commercially important crustaceans and finfish, have been reported to cause significant human health risks. It has been concluded that there is a very small risk to human health associated with these toxins in farmed finfish and crustaceans.

Table 4. Parasites associated with fishery products and radiation doses required for elimination of some parasites

Parasite class, And disease	Causative parasite sp.	Method of transmission	Host fish/shellfish	Radiation Dose*
Trematodiases Clonorchiasis	*Clonorchis sinensis*	Snail is the intermediate host.	More than 80 species of freshwater	0.15
Opisthochiasis	*O. viverrini & O. felineus*	The free swimming	fish including farmed	0.10
Paragonimiasis	*P. westermani*	cercariae from snail are released	cyprinids	0.10
Heterophyiases	*H. heterophyes, H. nocens, H. continua*	which penetrate and reside	Brackish water fish	
Metagonimus	*Puntius genionotus Metagonimus yokogawai*	in fish muscle		
Cestodiases Diphyllobothriasis	*Diphyllobothrium latum*, (tape worm) *D. yonagoense, D. pacificum*	Human and mammals are definite hosts	Freshwater fish, intermediate host	NA
Nematodiases Capillariasis Gnathostomiasis Anisakiasis	*C. philippinensis G. spinigerum A. simple P. decipens*	marine mammals, birds and pigs	Marine, brackish water or freshwater fish	7.0 2-10

* Minimal Effective Dose (MED) (kGy) required to eliminate ineffectivity. MED was determined using bioassays involving rats, hamsters, mice or cat. NA : Not available

Sources of biological hazards

Water is the most critical one that is responsible for hazards. The use of wastewater for fish farming or the practice of fertilizing ponds with animal manure may result in transmission of pathogenic bacteria and parasites to fish. Aquatic birds are known to harbour pathogenic strains of *V.cholerae* and *Salmonella* spp. which can infect the fish farms. The elimination of parasites or their intermediate snail hosts from water intended for public distribution in areas endemic for trematodiasis is difficult. In spite of recent practices such as putting crab fence and bird nets in the farms, it is impossible to control contamination by pathogenic bacteria in all aquaculture systems. Another important source of infection is feeds. The poor hygienic quality of fish meal used for aquafeed production may be source of contamination of organisms such as *Salmonella* spp..

Table 5. D10 Values of Some Pathogens in Fish/Shellfish Medium

Pathogen	Medium	Temperature (°C)	Atmosphere	D10 (Kgy)
Staphylococcus aureus	Surface of prawns	-10±2	Air	0.29
Vibrio cholerae	Surface of prawns	-10±2	Air	0.11
V. flavialis	Shrimp paste	-20	Vacuum	0.44
V. mimucus	Shrimp paste	-20	Vacuum	0.75
V. parahaemolyliticus	Shrimp paste, 1% NaCl	-20	Vacuum/air	0.44/0.07
V. parahaemoliticus	Fish homogenate	Ambient	Air	0.03/0.06
V. vulnificus	Shrimp paste, 1% NaCl	-20	Vacuum/air	0.30/0.35
V. alginolyticus	Shrimp paste	-20	Vacuum	0.19
Aeromonas hydrophila	Bombay duck homogenate	0	Air	0.14
A. hydrophila	Shrimp homogenate	0	Air	0.10
Shigella flexneri	Shrimp homogenate	Frozen		0.22
Salmonella paratyphi A	Oyster homogenate	5		0.75
S. paratyphi B	Oyster homogenate	5		0.85
S. typhimurium	Shrimp, mackerel, or golden anchovy homogenate	0-2	Air	0.10-0.15
S. typhi	Crab meat			0.87
Steptococcus fecalis	Shrimp homogenate			5-7.5
Bacillus cereus	Shrimp, mackerel, or golden anchovy homogenate	0-2	Air	0.2-0.3
Listeria monocytogenes	Shrimp, mackerel, or golden anchovy homogenate	0-2	Air	0.15-0.25
Yersinia enterocoliticus	Shrimp, mackerel, or golden anchovy homogenate	0-2	Air	0.10-0.15
Hepatitis A virus	Clams and oysters	Not stated	Air	2.02

coliforms, osmophilic moulds and fungi.

Application of low dose gamma irradiation for control of biohazards

The global demand for safe and wholesome fishery products has attracted application of precautionary measures in fish production and processing which include Good Manufacturing Practices and hazard Analysis at Critical Control Points. However, these efforts cannot fully eliminate many of the biohazards in fishery products. Exposure of foods to low doses of ionizing radiations from radioisotopes of cobalt or caesium or electron beam radiations has several advantages in this respect as compared with conventional techniques. It is a cold process, less energy consuming and does not leave any residue in the treated products. The salient features of food irradiation technology are summarised in Table 1. The benefits of irradiation of muscle foods including seafoods include reduction of spoilage-causing microorganisms for extension of refrigerated shelf life (radiation dose, 1 to 3 kiloGray (k Gy), destruction of pathogenic microorganisms in frozen fish and shellfish (4 to 6 k Gy) and elimination of parasites (1 k Gy). In 1980, the Joint Expert Committee under the aegis of Food and Agricultural Organization, International Atomic Energy Agency and World Health Organization concluded that any food irradiated up to a maximum dose of 10 kGy is safe for human consumption. (kGy is the unit of absorbed radiation: one kGy is equal to 1000 Gray, (Gy), and one Gy is equivalent to absorption of 10000 ergs of energy per g). In 1997 the Expert Committee has observed that in case a higher treatment dose is required for certain desired effect, it could be applied provided the food item can withstand the dose. Several professional bodies in the USA such as the American Medical Association, American Meat Institute, American Frozen Food Institute etc. have endorsed the safety of radiation processed foods. The food irradiation technology has been approved by 42 countries worldwide for treating over 100 food items and some are applying this at least on a limited commercial scale. The frequently asked questions on radiation processing of foods and answers to these questions are summarised in Table 2. Table 3 provides answers to public concerns on application of the technology to seafoods. Global experience has shown that most of these concerns are due to ignorance of the consumers on the new technology and proper education can remove the fear.

Low dose of radiation can have significant uses in aquaculture. The treatment effectively eliminates the infectivity of several fish borne parasites. For most of the parasites, the Minimal Effective Dose (MED) for their elimitation is in the range of 0.1 to 1.0 kGy (Table 4). It may be noted that the irradiation dose of 1 to 3 kGy required for shelf life extention of freshfish, as mentioned above, can also effectively eliminate infectivity of the parasites.

Gram negative bacteria, including pathogens such as *Salmonella* spp. are very sensitive to radiation. The D_{10} values, i.e., the radiation dose required for 90% elimination of the organisms, generally are in the range of 0.4 to 0.8 kGy. The D_{10} value is influenced by the type of organism as well as treatment conditions. Irradiation in the presence of fish components may slightly enhance the resistance. Table 5 gives the D_{10} values of several pathogenic microorganisms determined in fish/shellfish media under different conditions. Irradiation of aquacultured fish at doses ranging from 1 to 3 kGy can significantly reduce the biohazards. Crustacea such as oysters filter water and therefore harbour large proportions of pathogenic microorganisms including viruses. In comparison to bacteria, viruses require higher radiation doses for inactivation.

International status of seafood irradiation

As on December 2000, about 20 countries have accorded unconditional clearance for irradiation of various fishery products, including fresh, frozen or dried fish and shellfish products for shelf

life extension, microbial, parasite and/ or insect control. In the U.S., irradiation of seafood is under the consideration of the Food and Drug Administration. The International Consultative Group on Food Irradiation(ICGFI), established under the aegis of FAO.IAEA and WHO in 1984 helps to evaluate global developments in the field of food irradiation and provides guidlines on specific applications. The Codex Alimentarius Commission has adopted a General Standard for Irradiated Foods. The application of irradiation to individual food products including fish is covered in Special Code of Good Irradiation Practice elaborated by the ICGFI. The quality control system of the plant should be based essentially on the HACCP concept. According to Sanitary and Phytosanitary Measures (SPS), members of the World Trade Organisation (WHO), have the right to take legitimate measures to protect the life and health of their populations from hazards in food. Irradiation of aquacultured fish can immensely enhance its hygienic quality and protect the consumer, especially when these fish items are consumed as raw, minimally cooked or picked, as mentioned above, the radiation treatment plants may be of mobile type or centrally located near the ponds. The treatment therefore can ultimately result in an increased consumer confidence in the products and hence enhanced international trade.

Literature cited

1. Food safety issues associated with products from aquaculture. Report of a Joint FAO/NACA/WHO Study Group, WHO Technical Report Series 883, World Health Organization, Geneva, 1999.

2. Irradiation of fish, shellfish and frog legs. A compilation of technical data for authorization and control. International Consultative Group on Food Irradiation established under the aegis of FAO. IAEA and WHO, International Atomic Energy Agency, Vienna, June 2000.

3. Radiation processing to improve the quality of fishery products. V. Venugopal, S.N.Doke and P.Thomas. Critical Reviews and Food Science and Nutrition, **39**, 341-440,1999.

Foreign Technical Know - How : MPEDA'S New Scheme

The Marine Products Export Development Authority has earmarked a budget provision of Rs. 20.00 lakhs for the year 2002-2003 to secure foreign technical know-how for increasing the production of new products for augmenting the export earnings of the Country. The beneficiaries will be processors, exporters, aquaculturists and hatchery owners registered with MPEDA. The applications for assistance along with a detailed project report with techno-economic viability when received, will be placed before a Committee which will scrutinise them, and if approved, 50% will be met by MPEDA subject to a maximum of Rs. 5 lakhs per beneficiary/company per year. The balance has to be met by the beneficieries. The assistance extended covers (1) to and fro air travel, (2) a one time daily allowance not exceeding US $ 200/- per day for a specific period not exceeding 60 days and to meet local transportation cost, boarding and Lodging expenses and (3) A lumpsum technical know how fee.

This is a good opportunity to develop new projects or to export new value added products. For further details interested enterpreneurs may contact MPEDA, MPEDA House, Panam Pilly Avenue, Cochin - 682 036.

Satellite Remote Sensing Application in Marine Fisheries

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India has an EEZ area of 2.02 million sq. km. and the potential yield of fishery resources from this area has been estimated to be 3.92 million tonnes. Most of Indian fishing operations are confined to the continental shelf area up to 75 m depth, exploiting around 2.6 million tonnes of the resources, leaving most of the remaining resources, which are in the oceanic regions, under-exploited. For exploiting the full potential, a thorough knowledge of the ocean dynamics and migration patterns of the oceanic species is essential. To obtain these data the dependence has been on ships, buoys etc., which, besides being expensive and difficult to be in continuous touch, were found inadequate for proper modeling. The urge for more effective means for acquiring data prompted the use of the advanced satellite remote sensing technology.

India made her first attempt in space with the launch of Bhaskara I in 1979. Since then the Indian Space Research has witnessed rapid growth, even acquiring the ability to launch a geosynchronous satellite. Ushering in these developments in space research, the Department of Space started its initial study on remote sensing of the marine resources using the Advanced Very High Resolution Radiometer (AVHRR) data of National Oceanic and Atmospheric Administration (NOAA) satellite by late 70s. This research activity continued for over a decade and this helped in acquiring thorough knowledge of the sensor requirements and algorithms for our tropical seas.

The first well-designed Indian satellite dedicated for oceanographic purpose - Oceansat (IRS P4) - was launched on 26th May, 1999. This satellite is having onboard, among the array of sensors, an Ocean Colour Monitor (OCM) capable of retrieving chlorophyll intensity using its 8 wavelength bands, and a Multi-frequency Scanning Microwave Radiometer (MSMR) - capable of retrieving sea surface temperature, and sea surface winds that could give information on the wave patterns using the 8 channels. The satellite has a repetetivity of 2 days covering Arabian Sea and Bay of Bengal on alternate days. It has a special resolution of 350 m and has a swath of 1,420 km.

The aquatic organisms are known to migrate mainly in search of food and for breeding seasonally, depending on the physical, chemical and biological environmental conditions and/their own physiological state. It is well known that all living resources including finfishes, crustaceans and molluscs are dynamic and self-sustaining in nature. In the Indian sub-continent, which is in tropical belt, light is not a limiting factor, while nutrients become a limiting factor for productivity and growth. This is overcome in nature by continuous churning for the proper mixing of nutrients. Various oceanographic processes like upwelling, currents, advection and turbulence help in the vertical mixing of nutrients. The nutrient enrichment by these biophysical processes prevailing in an area enhances the biological productivity. The technique adopted for forecasting Potential Fishing Zone (PFZ) is primarily based on the concept that fishes have the tendency to congregate in the areas of high productivity rich in nutrients and planktonic biomass which forms forage of many fish species.

The important factors that are having an influence on the short distance migration of the aquatic organisms include temperature of the water column, wave intensity, direction and velocity (physical), dissolved oxygen, pH (chemical), availability of chlorophyll, presence of toxic algae (biological), etc. The aim of the ongoing R & D activities between the ISRO institutes and Fishery Survey of India (FSI) is to progressively incorporate this knowledge with satellite data to predict the fishery status/scenario of the nation.

Scientific Rationale

Biophysical features and processes act as a catalyst for the aggregation of fish in the oceans. Timely availability of satellite data and identification of these features are important for the PFZ forecast. The Sea Surface Temperature (SST) information is being used for PFZ identification for over a decade now (Narain *et al.*, 1990, Narendra Nath *et al.*, 1992. Narain, *et al.* 1990) held a view that every narrow temperature range usually prevailing in Indian waters may not be possibly linked to the availability of fish. However, fish catches can be associated with the proximity of temperature front(s). They also opined that apart from the magnitude of the temperature gradient being useful for locating fish-rich areas, another factor that should play an important role is the persistence of a thermal feature over a long period of time. Since on a given day, not much variation occurs in SST in the Indian waters, many features of minute nature (but of vital relevance) were not seen in a SST image. This lacuna has been filled by the ocean colour information. Ocean colour is an indicator of the first level productivity of the ocean, which in turn triggers the column information and reveals subsurface picture of water circulation and water productivity and therefore can be detected even during summer. Presently

synchronous IRS-P4 OCM and NOAA-AVHRR SST data is used for the identification of PFZ. The fishery and oceanographic data collected by ships' cruises are being used for the forecast validation.

Methodology

The Space Application Center (SAC), Ahmedabad and Fishery Survey of India (FSI) have been jointly evolving an integrated approach using OCM derived chlorophyll and AVHRR derived SST for locating PFZ as explained hereunder.

Oceanographic Features of Processes Responsible for Aggregation of Fish

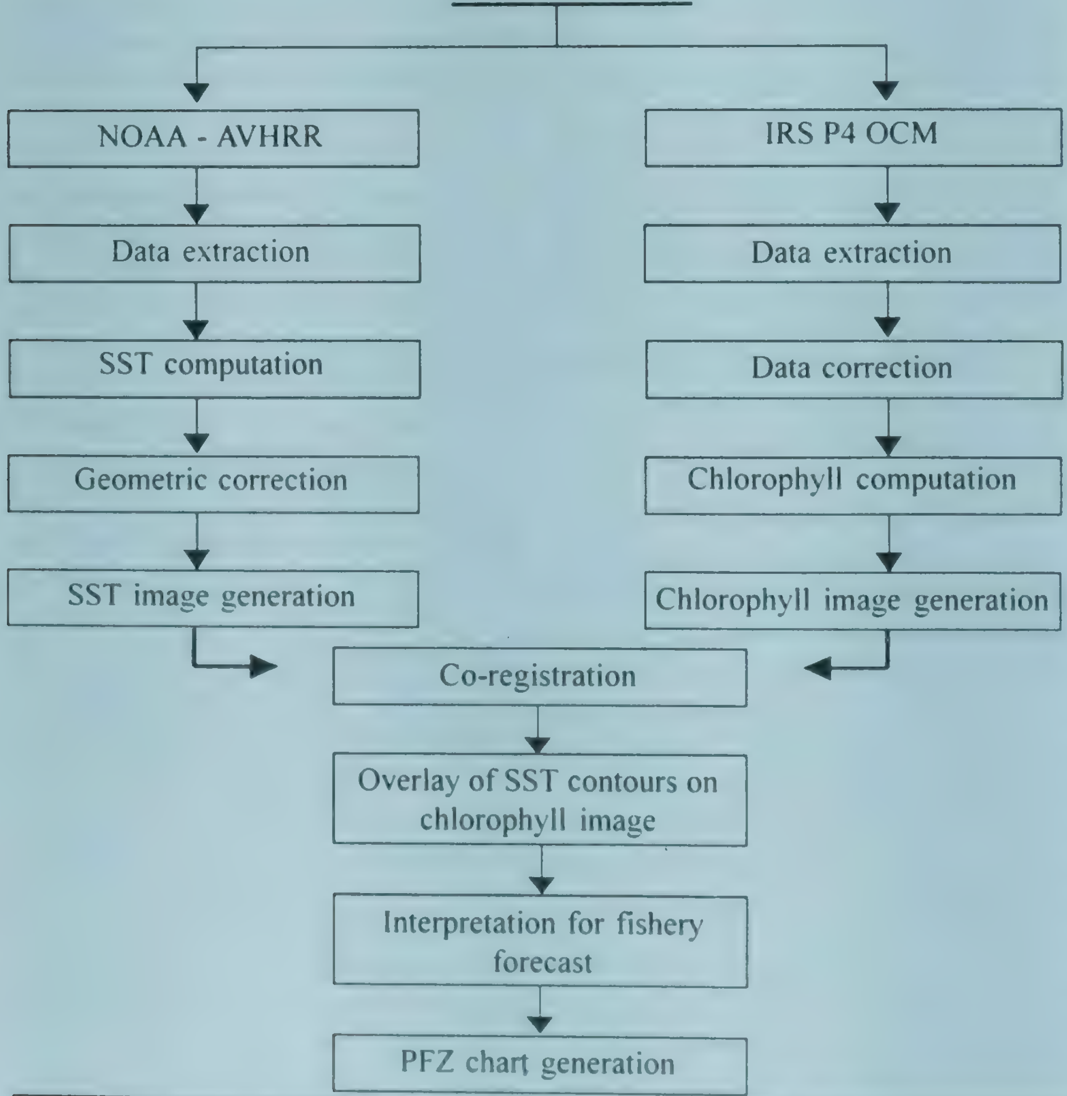
Fish aggregation is usually observed in areas of high productivity, which is effected by factors like temperature fronts, upwelling, eddies, etc., making that area more rich in nutrients and phytoplankton. While considering the upwelling areas it is important to discriminate about the state of the upwelling zone (identifying areas having negative effect due to depletion of oxygen). The high productivity of the zone, first noticed as a divergent front in both thermal as well as primary productivity, is often associated with current boundaries (Laevastu and Hayes, 1981). Seasonal reversing of winds in Arabian sea results in large scale change in SST bringing the nutrients to euphotic zone (Banse and Macclain, 1986). Earlier, Tragariza *et al*. (1981) have observed relationship between sea surface nutrients concentration and high productivity, and successfully studied it using satellite remote sensing techniques. The features seen on the SST and OCM maps, which stabilise the high productivity of this region, are as follows : 1) Thermal/colour fronts; 2) Wind speed and direction; 3)Eddy formation; 4) Upwelling areas; 5) Meanders 6) Cold/warm core rings; and 7) Algal bloom.

The productivity is indicated by the higher concentration of chlorophyll in the area and usually these areas are characterised by having lower temperature than the adjacent areas.

Key for Feature Selection

The features for PFZ selection are indicated taking into consideration the extent of the area, magnitude of gradient, shape of the front, possibility for its persistence and operational constraints. Divergent fronts, eddies and meanders are indications of the ongoing oceanic process resulting in high productivity in that area; which are possible PFZs. The advanced phase of productivity is indicated as chlorophyll features and probably in SST image also as follows: 1) Strong gradients; 2) Persistence; 3) Features seen on both colour and SST image; 4) In the case of upwelling stabilization phase; 5) Centre of the core ring; 6) Edges of the warm core ring; 7) Anticyclonic eddy; 8) Cyclonic eddy; 9) Fishing limits; and 10) Vessel position in case of survey vessels

PFZ Generation



Indian experience in Evolving the Satellite Remote Sensing Technology

The inter-relationship between satellite derived Chlorophyll (Sea WiFS images) and temperature profile data (FSI vessel based collection) during 1997-'98 was attempted by Chaturvedi, *et al*., (2000), which shows varying degree of association during different months. However, during February - March the subsurface level (1 m. depth) temperature and chlorophyll contents had good correlation. In an earlier study Narain *et al*. (1983) obtained radiance data from aircraft and concluded from the relationship between upwelled radiance ratio and pigment, (based on sea truth data) that a minimum of three spectral channels centered at 445, 520/550 and 670 nm will be quite useful in ocean colour sensing. At certain level they observed that with a marginal increase in chlorophyll - a, the fish catch recorded about two-fold increase. A sigmoidal relationship was noted between fish catch and chlorophyll 1-a concentration (Narain *et al*., 1998). As a part of IRS utilisation programme in marine fisheries project

Narain *et al*. (1989) revalidated the technique developed for locating potential fishing ground pertaining to the period March-April 1989. The SST data from NOAA-AVHRR and the georef red fish catch data obtained by the FSI vessels through near-synchronous fishing operation and the fish landing data along Gujarat coast have shown higher correlation.

In preparation for the launch of NIMBUS - 7 carrying the coastal zone colour scanner, two major vessels obtained sea-truth measurements, while two jet aircraft at altitudes of 12.5 and 19.5 km obtained images of the surrounding ocean in spectral bands centered at 442, 519, 551 and 670 nm for sensory ocean colour (Austin, 1980). A blue colour is an indication of oligotrophic water whereas a green colour shows euphotic water. It therefore seems natural, as reported by Hoelrslev (1988), to expect a relationship between the colour of the sea, its primary productivity level and concentration of phytoplankton in the surface waters (or the concentration of any other connected parameter like chl-a).

The concept of a reliable PFZ is that, the area identified should be more abundant with resources than the other areas and the forecasts are validated by comparing the month-wise, vessel-wise and depth-wise average CPUE and standard deviation within the PFZ areas. The results were interpreted using the geometrically corrected series of image on which the fishing track was recorded. These images of time series were used to understand the reasons for variability in catch and shift of features. All the forecasts made in the depth zone 50-100 m yielded relatively high CPUE than the other areas (Fig. 1).

It is noticed that, with time the frontal features shift by the effect of underwater currents and wind that are having an effect on mineral and plankton distribution. Hence the decrease in catch with increase in time lag is reasonable (Fig. 2). It is also noticed that the magnitude of the catch depends on the direction of fishing. Another factor influencing the catch is the distance of the fishing ground from the frontal features.

Most of the forecasts stood positive where the time lag in fishing was minimum. The few negative results obtained were in depth zone of 30-50 m when the time lag was more resulting in considerable shift of the features and undesirable direction of fishing operation (due to limitations of the operated vessel).

From the foregoing account it is clear that the remote sensing technology has immense possibility for developing a reliable fishery forecast system.

Significance of the Satellite Technology

Application of satellite remote sensing technology will have following advantages in moving towards its perfectness in forecasting fish rich areas: a) Help in reducing the search time for the proper fishing ground thereby reducing total fishing time and expense; b) Along with proper implementation of fishing laws (seasonal mesh size regulation of the net in the PFZ, seasonal restriction for vessels etc.) it facilitates optimum utilisation of the sea wealth; c) An estimate of primary productivity and fish stock can be attempted using this method; and d) The satellite data could give information on weather ensuring greater safety for the men out at sea.

Limitations of the Technology

In evolving the applications and in achieving the precision and perfection in forecasting the PFZ, following issues need to be addressed.

- Time taken for the fishing activity in the proposed site is the most significant limitation. It is observed that the catch is directly proportional to the magnitude of the features and inversely proportional to the time lag. This difficulty can be overcome in the future by forecasting the direction of movement of the front by studying the effect of current and wind.
- Generally, for good catch, the fishing track should be parallel to the front. But this may not be possible always because of the adverse current and wind.
- Sometimes the area selected as PFZ may not be suitable for bottom trawling because of uneven bottom. This difficulty can be got over by making a bottom profile map and using the same for further forecasts.
- In the monsoon season the clouds block the field of vision of the satellite sensors making it difficult to get a clear chlorophyll image and hence forecasts cannot be generated during this period.

Future Scenario

Having evolved the manner of application of the satellite remote sensing technology to marine fisheries forecasting over the past two decades and launching of devoted ocean application satellite (IRS-P4) in 1999, Indian effort in future will be for making the forecast efficient, accurate and reliable. The fisheries applications of satellite remote sensing should not only relate to the short term forecasts as of today but should endeavour to have necessary input of this advanced technology in long term forecasting of fish stocks. The ultimate aim of developing the technology should be the exploration of oceans for synoptic assessment of fish stocks, monitoring control and surveillance over sustainable fisheries and management. Towards achieving these objectives, investigations in the following areas and the resultant inputs will be crucial in nature.

- Intensive data analysis activity is necessary to overcome the problems such as variations in the factor associated with time lag, shifting of chlorophyll fronts within the forecast period, possibility of incorporating wind speed parameter, multiple modeling, etc.
- Review on ecomorphology of few relevant species has to be attempted.
- Apart from the parameters of chlorophyll and sea surface temperature, there is need to consider other parameters like wind speed and direc-

tion, currents, bathymetry, sediment load etc., related to fish behaviour for precise detection of PFZ(s).

- Geographical information system (GIS) emerged out as a very powerful tool to store, collect, retrieve, analyse and integrate various kinds of data - spatial or non spatial, for planning and decision making in fisheries sector with recent advancement of computer technology, hardware and software. The sustainable development of fisheries will lead to improving the socio-economic condition of fishermen and upgrading the activities of entrepreneurs.

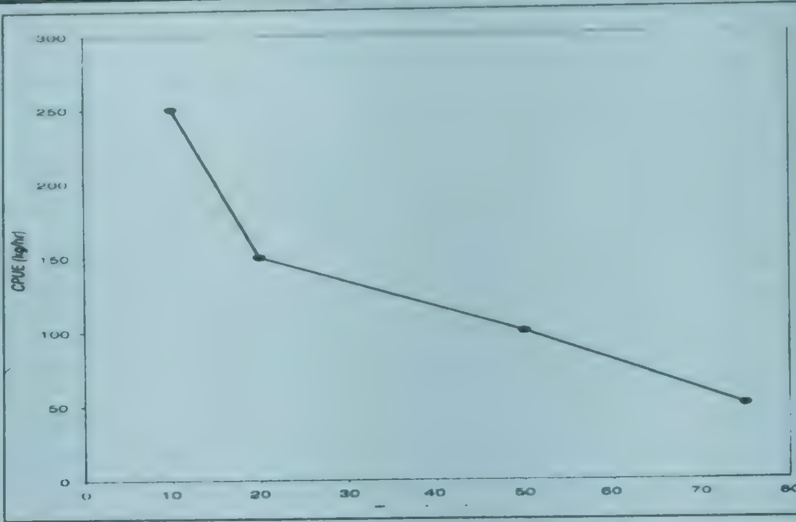


Fig 2: Relation between CPUE (kg/hr) and Time lag (hrs)

- Effects of environmental parameters on the fishery resources need to be studied and co-related with fish aggregation.
- Assessment of primary productivity on monthly or quarterly basis has to be made based on the satellite derived chlorophyll data.
- SST and chlorophyll information derived from NOAA-AVHRR and IRS-P4 OCM respectively can be used to incorporate the parameters in the GIS environment. Multi-date and multi criteria data can be used for developing model in GIS to improve decision-making capability for identifying PFZs.

Thus, in view of the significance of the technologically advanced applications to marine fishery as discussed, and limitations to be addressed as detailed above, the role of the satellite remote sensing will remain as complementary to the fishery-based knowledge for quite sometime to come. However, as we advance in addressing the issues involved in perfecting the technology embracing various relevant oceanic, biological and environmental processes responsible for aggregation of fish populations, the technology undoubtedly is going to be of immense use for coastal as well as high sea fishing practitioners especially for those who venture for tuna fishing in national EEZ and in waters adjacent to the national waters. The scientists engaged in space research as well as in fisheries research face great challenges thrown before them by the resources in seas and associated natural processes and their dynamics. They also face a challenging situation in evolving suitable technologies and for their applications in short term as well as long term forecasting of non-living resources in the seas around the country. The Indian Scientists working in the respective disciplines are well prepared and intend to accept these challenges in coming years for extending the benefits of the modern and exciting technology to the fishermen and deepsea fishing operatives.

Acknowledgements

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References

AUSTIN R.W. 1980 Gulf of Mexico. Ocean Colour Surface - truth measurement. *Boundary - Layer Meteorology* **18**, 269-285.

BANSE. K. and MACCLAIN. C.R. 1986. Indication blooms of phytoplankton in the Arabian sea as observed by the coastal zone colour sensor. *J. mar. Ecol.* **34**:201-211 pp.

DWIVEDI. R.M., H.U. SOLANKI. P.C.M. MANKODI. A. NARAIN. V.S. SOMVANSHI. T.E. SIVAPRAKASAM. D. SUDARSAN. G. SUBBARAJU and P.S.B.R. JAMES 1989. Validation of remote sensing technique to direct fishing efforts. Indian Remote Sensing Utilisation Programme. IRS-UP/SAC/MAF/SN/08/89 : 20 pp.

HOJERSLEV. N.K. 1980 Water colour and its relation to primary production. *Boundary - Layer Meteorology*, **18**, 203-220.

LAEVESTU. T.and HAYES 1981. *Fisheries Oceanography and Ecology*, Fishing News Books Ltd, England : 199 pp.

NARAIN. A., K.M. JOSEPH. E.G. SILAS. R.N. JADHAV. V.S. SOMVANSHI. P.V.R. NAIR. G. SUBBARAJU. G.S. SHARMA. K.L. MAJUMDER. V.K. PILLAI. A.G. PONNAIAH and V.K. BALCHANDRAN 1983. Joint experiment programme in remote sensing of marine fish resources. *National Natural Resources Management Systems* (NNRMS), **VI** (2):26.

NARAIN, A., R.N. JADHAV, K.L. MAJUMDER, G.S. SHARMA, K .M. JOSEPH, V.S. SOMVANSHI, E.G. SILAS, P.V.R. NAIR, G. SUBBARAJU, V. K. PILLAI, A.G. PONNAIAH and V. K. BALCHANDRAN 1983 Remote Sensing Application to Assessment of Marine Resources along the West coast of India, *Proceedings of the fourth Asian Conference on Remote Sensing*, Nov.10-15, 1983 Colombo, Sri Lanka.

NARAIN. A., R.M. DWIVEDI. H.U. SOLANKI. BEENA KUMARI. N CHATURVEDI. P.S.R.B. JAMES. G SUBBARAJU. D. SUDARSAN. T.E. SIVAPRAKASAM and V.S. SOMAVANSHI. 1990. The use of NOAA AVHRR Data

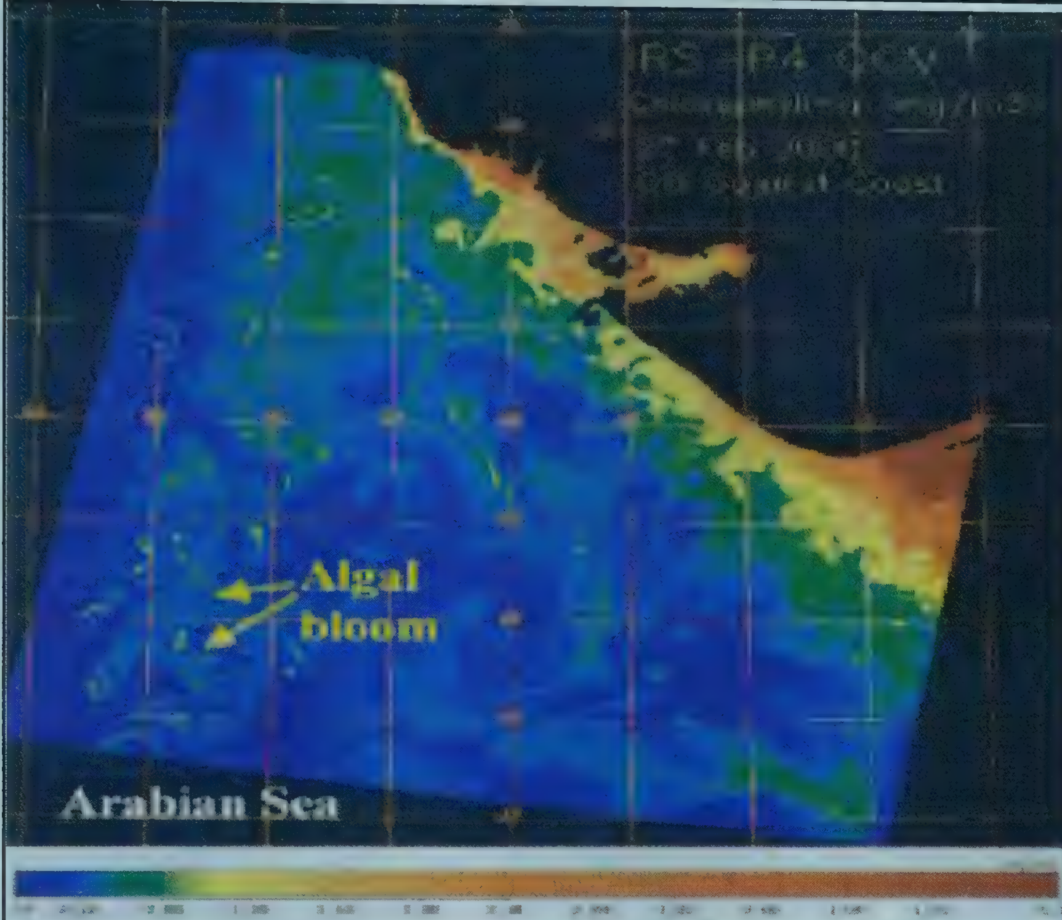

Fig 1: Forecast showing colour frontals with high productivity

for fisheries exploration in the Indian EEZ. In : *Remote Sensing for Marine Studies : Report of the Seminar on Remote Sensing Applications for Oceanography and Fishery Environment Analysis*. Co-sponsored by the National Remote Sensing Centre, State Science and Technology Commission of China and the ESCAP/UNDP Regional Remote Sensing Programme (RAS/86/141), Beijing, China : 226-232.

NARENDRA NATH A., M.V. RAO, K.H. RAO, D.E. NATHANIEL, T.V. RAMANA, SUHASINI, G., VENUGOPAL AND D. JOGENDRANATH 1992. Satellite forecasting for marine fishery resources exploitation along Indian coast. *Interface*, **3** (4):1-3.

NEERA CHATURVEDI, AISHWARYA NARAIN, D.K. GULATI, M.E. JOHN and V.S. SOMVANSHI 2000. Inter relationship between satellite derived chlorophyll and temperature profile from cruise data : a study for Arabian Sea on seasonal basis, *PORSEC* proceedings. **I**:347-349.

TRAGANZA, D.E., SILVA, M.V., AUSTIN, M.D., MANSON, L.W. and BRONSINK, H.C. 1981, Nutrient mapping and reoccurence of coastal upwelling centers by satellite remote sensing : Its implication to primary productivity and the sediment record. In : *Coastal Upwelling* (Eds. Erwinsuess and John Thiede) :61-83.

B.N.Singh : New Deputy Director General (Fisheries) ICAR

Dr. B.N. Singh

Dr. B.N. Singh has taken over as **Deputy Director General (Fisheries)** in ICAR on 2nd May, 2002. Readers may like to know that, so far as his qualification are concerned he obtained his M.Sc. and Ph.D. degrees in Zoology (Fishery Biology) from Banaras Hindu University in 1963 and 1996 respectively. He was selected in 1968 as "Designated Representative in India" by Smithsonian Institution, Washington, U.S.A. for higher studies. Later he worked under Prof. G.M. Hughes at Bristol University, England for 4 years i.e. 1968-72 at Research Unit for Comparative Animal Respiration, at the University on Respiratory Physiology and Bioenergetics. His work on gas exchange and metabolism of Indian air-breathing fishes received high acclaim and it was published in several books including the one on Respiration of Amphibious Vertebrates 'published by Academic Press', London.,

B.N. Singh joined as Junior Fishery Scientist at Central Inland Fisheries Research Institute, Barrackpore in December, 1974. Having worked in various research positions, he joined as Assistant Director General (Inland Fisheries) at the ICAR's Headquarters in Delhi in January, 1999.

Singh made commendable contribution to fish physiology, nutrition and reproductive physiology. He was FAO Fellow and Visiting Scientist at Department of Fisheries and Allied Aquaculture, Auburn University, U.S.A. in 1984 for higher research in fish nutrition, digestive physiology and aquaculture. By virtue of his work he became one among its Alumini in 1984. Singh is a member of Technical Advisory Committee of Network of Aquaculture Centres in Asia-Pacific (NACA) from ICAR, India.

135 research papers were authored and published by him in reputed national and international journals. He participated in a number of international and national symposia/workshops on fish nutrition/physiology and aquaculture in several countries i.e., West Germany, Irish Republic, England, Thailand and Cambodia.

B.N.Singh is a fellow and member of several reputed societies and academies including Fellow of the National Academy of Agricultural Sciences (FNAAS), New Delhi. He was awarded V.G.Jhingran Gold Medal for 1999-2000 for his contributions to Aquaculture and Fisheries in India, by the Society of Nature Conservators.


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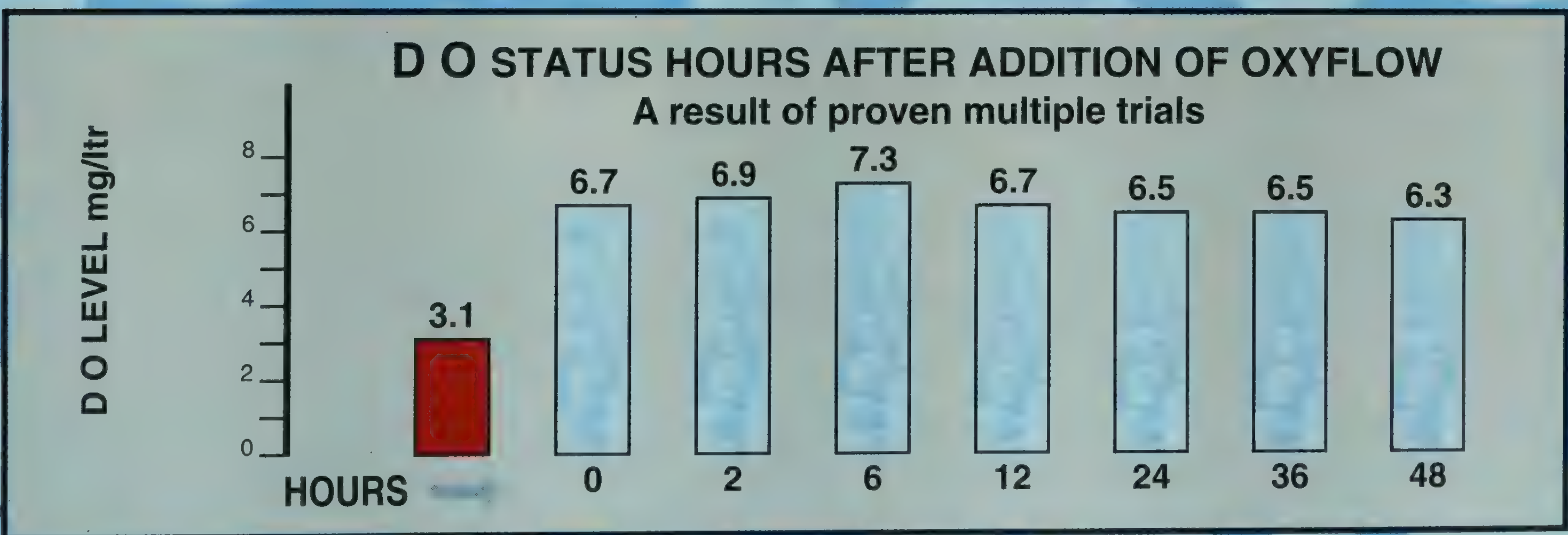

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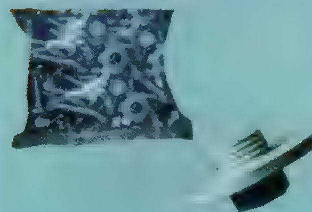

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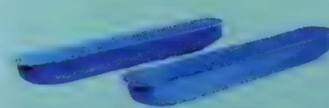

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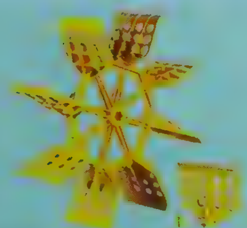

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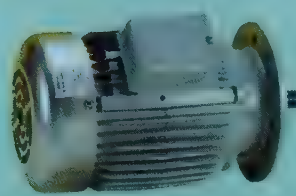

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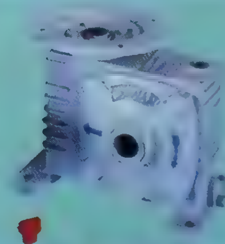

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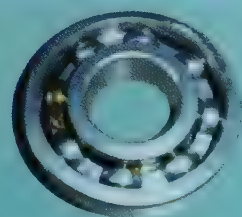

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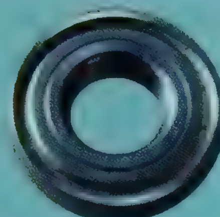

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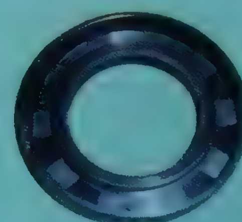

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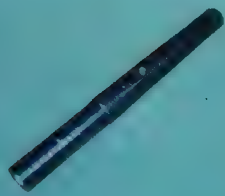
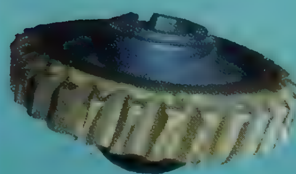


Output Shaft



Worm Gear Wheel (14:1)

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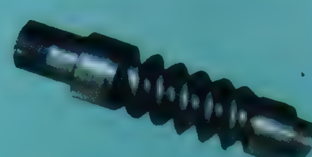

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On Commercialisation of Fisheries Technologies

S.K. Bhatnagar
Deputy General Manager, National Bank for Agriculture and Rural Development, Mumbai.

Fishing for subsistence living has been a vocation from times immemorial and it can be considered as one of the earliest professions to get over hunger. Till almost early 1970s it was considered as a traditional activity which involved fishermen living along the sea coast with traditional boats and nets made of natural fibres. Introduction of nets fabricated with synthetic twine was probably the first step towards changing from subsistence fishing to commercialised fishing in marine sector. This transformation started with the introduction of motorisation followed by mechanisation of boats. This had enabled harvesting of fishes in larger quantities from the sea. So far as inland freshwater and brackishwater sectors are concerned, the development of technologically superior aquaculture technologies for seed production and culture excercised a profound influence on traditional fish farming activities which were being practised at that time mostly in the States of W.Bengal, Orissa and Kerala. The result was that, as time went by, the advanced technologies came to be adopted not only in these States but in all the States of the country.

Commercialization thus can be defined as a process wherein the productivity from aquaculture is improved by using higher input-output ratio, introducing market orientation towards generation of higher returns from the activity. It is axiomatic that any activity which is commercialized would have to be carried out on a sustainable basis, for the benefits to percolate to the comman man and the society as such on a continuous basis.

By 1970s, India has developed a strong scientific and technological base for fisheries development. So much so there has been a remarkable progress in the development of various technologies at the various fisheries research institutes. However, commercialization has not kept pace with the progress in the development of technologies. Only a few of them could be adopted by entrepreneurs in the field, Undoubtedly there is considerable scope for commercialization of several technologies developed by the research institutes. There is also scope for securing such of the proven technologies developed in other countries for commercial application in India. One of the parameters that could probably indicate whether a technology has been commercialized or not is the involvement of institutional finance for providing support to the activity.

Commercialization of any technology is a complex process involving intervention of different agencies in the process, after the technology has been developed and perfected in the laboratory and later in the field by the scientists. The most important role in the transfer of technology has to be played by the scientists who have developed the same. They have to introduce technonology for adoption in the field, nurture it, as parents do of their child, taking care of all the problems till the recipient of the technology reaches a stage where he can adopt the technology with confidence. In other words, the role of a scientist does not end with developing and perfecting a technology, but it continues till the technology is effectively passed on to the end user, who can be either a farmer on an entrepreneur. There is a responsibility on the scientists not only to transfer technology to end-users but also to ensure that the transfer is fortified by providing necessary help to them as and when required. Further, the scientists would be able to discharge their function effectively, only when there is active involvement of the concerned State Fisheries Department in the transfer process. For this there is need to develop a standard procedure that delineates the contours of participation of the concerned fisheries officers in the process. When the officer concerned picks up the technology that is to be further transferred, follow-up action would become convenient.

Commercialised Activities : Over the years several technologies were developed by our scientists. Dr. Hiralal Chaudhuri and his colleagues were the first in the line after independence in the development of technologies. They developed the technology of induced breeding of major carps as early as in July, 1957. However, it took more than two decades to commercialize induced breeding technology on a significant scale i.e., after the introduction of Inland Fisheries World Bank Project and introduction of circular Hatchery design in the country following Chinese model. This is an instance of time lag for mobilising other parameters required for commercialization of a technology. The other technologies that have been commercialized and are being adopted by the entrepreneurs in the country are as follows:

Carp Hatchery: The basic technology of induced breeding by hypophysation has been noticeably commercialized through introduction of Circular spawning and hatching tanks based on Chinese model and the technology is being used most successfully adopted in the country by the farmers. This has played a major role in the mass scale production to increase the production of carp seed in the country.

Composite Fish culture: The composite fish culture system involving three Indian carp varieties and three exotic carp varieties of fish is being followed with a number of variations introduced

by the farmers depending on the availability of needed fish seed for increasing fish production. This has resulted in increasing fish production from the farms to a level of 7-10 t/ha/yr, thereby increasing the average national culture fish production per ha in the country to over 2 t/ha/year.

Integrated Fish Farming: Fish farming has been sucessfully integrated with live stock, agriculture plantation and horticulture activities. Several leading and progressive fish farmers have adopted a number of such integrations as follows: a) Paddy cum fish culture; b) Banana cum fish culture; c) Vegetable cum fish culture; d) Dairy cum fish culture; e)Poultry cum fish culture; f) Piggery cum fish culture; g) Duck cum fish culture; and h) or a combination of more than one of these activities along with fish farming.

Shrimp Farming: With the liberalisation of imports, shrimp feed in now available in the country without any constraints. So also, the employment of foreign experts by Indian enterprises is no longer difficult. These developments have facilitated the shrimp farming activity to pick up during early 1990s, highlighted by a number of Corporate houses entering the shrimp farming business. Litigation against shrimp farmers in the CRZ initiated by environmental activists pointing out pollution problems, salinisation of land adjacent to shrimp farmers, and the onset of white spot virus disease among cultured shrimps resulted in a setback to the sector. The final judgement of the Supreme Court, establishment of Aquaculture Authority of India and the Authority issuing licenses to shrimp farmers has been bringing back the activity to normalcy. Permitting only traditional culture, has forced all large companies to abandon the farming part of the activity, with some of them continuing to operate hatcheries and feed mills.

Shrimp Hatchery: After the successful demonstration of tiger shrimp hatchery management by MPEDA through the induction of related technology from USA and France, a number of private shrimp hatcheries came into being all along the coastline, with concentration in the States of Andhra Pradesh and Tamil Nadu. This development has facilitated production and supply of shrimp seed to the farmers, and acted as a disincentive to wild shrimp seed collections.

Freshwater Prawn Farming: Giant FreshWater Prawn *Macrobrachium rosenbergii* commonly referred to as Scampi, is fast becoming a substitute for shrimp farming activity, the reason being the problems faced by shrimp farmers in getting supplies of disease-free shrimp larvae. The activity has picked up in the States of Andhra Pradesh, Maharashtra, Tamil Nadu and Orissa.

Freshwater Prawn Hatchery: Infrastructure requirements for production of shrimp and giant freshwater prawn seed being generally similar, some of the entrepreneurs owning shrimp hatcheries have converted them into giant freshwater prawn hatcheries, as the shrimp seed production sector is facing problems such as non-availability of gravids, particularly those free from whitespot virus.

Mussel Farming: This activity has been commercialized by CMFRI in the State of Kerala and a number of units are operating on small scale. They are dependent on natural seed collection as the hatchery technology has not yet been commercialised.

Marine Fisheries: Commercialization of marine fishing technology has resulted in enhancement of fish production from marine resources. One offshoot of this commercialisation was that the resources up to 50 m depth are overexploited, leading to introduction of conservation measures by coastal States under State Marine Fishery Regulation Acts for sustainable coastal fisheries development. The technology of upgradation which helped successful commercialization are:

1) Introduction of synthetic twines for various types of gear used for fishing has increased the life of the gears, thereby improving the catches and economics of the activity.

2) Motorisation of traditional crafts helped to increase the area of operation of the vessels and in bringing the catches in good condition due to faster movement of the boats and taking of ice for preservation on board. Thus technological upgradation has facilitated earning of higher returns, exploration of newer areas for fishing and reduction of risk to life.

3) Introduction of trawlers and purse seiners has changed the concept of fishing. Instead of waiting for fishes to come nearer to shore or areas accessible to traditional vessels, now trawlers and purse seiners go to farther fishing grounds for catching fish. Introduction of trawl and purse seine nets has helped in a big way by not only improving the catches and socio-economic conditions of fishermen but also by earning valuable foreign exchange.

Processing and Value Addition: These are the other areas where commercialization of the technologies took place in the country. Initially block freezing process was adopted. Subsequently value addition to products was introduced by way of IQF, Freeze Drying etc., thereby increasing exports earnings.

Commercialisation Issues: A number of new technologies have been developed by Indian scientists, who claim to have perfected them in the laboratory as also in the field but these have not been commercialised so far. Some of them are: Marine pearl culture, Freshwater pearl culture, Edible oyster culture, Sea weed culture, Sea Bass Hatchery system, Air Breathing Fish culture etc. The reasons for non-commercialization of these activities are not known. An effort is made in the following paragraphs to discuss as to what steps need be taken before a technology could be commercialized.

Policy guidelines: Commercialisation of the technologies as indicated earlier need involvement of a number of agencies. Common resources owned by individuals or Government need to be utilised in a sustainable manner and in an eco-friendly manner. This calls for determination of the technologies that have

to be applied and in that light plan for necessary facilities required or changes needed in the existing policies. The best example in this context is inland fisheries development under which carp hatcheries and carp farming have been commercialised and they are being run in a sustainable manner. In contrast, shrimp farming, which too has been commercialised, now presents problems. After a boom in the initial years of commercialisation, the activity had to suffer, because it was allowed to grow unplanned, resulting in problems of pollution, disease outbreaks, social tensions etc., and a litigation in supreme court. The most important areas where interventions, aimed at regulation through proper planning, are required in the mariculture sector are identified as follows :

Infrastructure Facilities: Before an activity and technology thereof can be commercialized it is necessary that all the basic infrastructure required for its implementation is made available to the entrepreneurs so that the transformation of the technology could be smooth. A policy in respect of leasing demarcated water plots for undertaking mariculture through cage systems or by other means needs to be formulated and implemented. There have to be channels of supply of seed and feed required for sustainable development of mariculture both on coastal lands and out at sea.

It is known that although carp farming has become very popular in the country, the dependence is still on oil cake and rice bran for feeding the fishes, notwithstanding claims that a number of feed formulae have been developed by various research institutes. Secondly, it is still a matter of debate in respect of the best way to increase fish production from 2t/ha/yr to say 5t/ha/yr. Further, several questions remain unanswered : What would constitute the best feed ingredients, what would be the best feed formula, and what would be the economical FCR to be used, have not yet been answered. The same situation prevails in the case of mariculture activities. Commercial hatcheries for producing seed of prime fish species other than major carps have not yet come up in the private sector. Mariculture in a limited way is taking place in the field through the use wild seed collections. Another area that needs immediate attention is the development of brookstock of tiger shrimp in the farms so that dependence on the natural collection for broodstock could be avoided and disease-free domesticated brooders could be utilised for seed production for supply to farmers.

Identification of Proper Technologies: A number of technologies are developed through research by the scientists. However, all of them may not be suitable for commercialization. As such, it is necessary that before starting the process of commercialization, various factors are taken into consideration as outlined hereunder :

1) ***Suitability*** : Suitability of a technology is the most important criterion for its commercialization as its adoption would cause minimal problems. This approach is all the more applicable in case of transfer of technology from other countries. Any technology adopted should be tested in Indian conditions before recommending the same to the farmers.

2) ***Forward and Backward Linkages*** : Proper forward and backward linkages play a major role in the successful implementation of the technology and its commercialization. These aspects should be first evaluated and ensured so that investments made in the sector may not go waste. Local market for the product should be developed and importing countries should be identified and necessary survey and contacts should be established with those countries for ensuring regular and adequate returns. In the absence of proper markets, a number of by-products and value added products developed and perfected by CIFT and IFP could not be commercialized. Similar problems have been faced by the fishing industry in exporting value added products to other countries. Proper landing centres, and processing facilities of high standard are some of the other items that may need attention.

3) ***Social and Environmental Issues***: Every technology that is commercialized should have involvement of individuals, societies, and groups of people. When applied on a very large scale a technology can have effect on the ecology and environment of the particular area since these are land-based technologies and involve water, a very vital ingredient, which has many other uses i.e., for drinking, irrigation, washing cattle, religious purposes etc., depending on the location. Water seepage problems are encountered since farming is done in earthen ponds. These have created both unavoidable and avoidable problems. These include social tensions because of common use, conversion of agriculture or mangrove lands into fish ponds and salination of lands adjacent to the ponds and of freshwater around due to seepage etc. In view of these after-effects, the pros and cons of commercialization of the technologies should be thoroughly analysed before their transfer and necessary steps should be taken to mitigate the genuine difficulties of the people involved/affected consequent to the commercialisation. In the marine sector mechanisation has created rift among the mechanised and non-mechanised boat owners, resulting in demarcation of fishing areas. Unfortunately, in the absence of proper monitoring, such problems are continuing.

4) ***Perfection at the Field Level on Commercial Scale***: It is a normal tendency at the field level that once an experiment is successful it is highlighted as achievement and it is taken for granted that it should be transferred to the field. Normally most of the experiments should be replicated on a commercial scale and the results should be rechecked at least thrice over a period of time before claiming success so that all the problems and variations that are faced during the rechecking phase can be eliminated. Such an approach will enable adoption of commercialised technologies in the field with confidence.

5) *Import of Technologies*: It is possible that in spite of the efforts of the scientists commercialisation of some of the technologies proves difficult because of unsurmountable problem or problems. Under such circumstances. The concerned institute should opt for import of suitable technologies with tie-up arrangements for its transfer to Indian counterparts. This approach was adopted at the time of establishment of the first two shrimp hatcheries in India. MPEDA imported the technology and established one hatchery each at Visakhapatnam and Gopalpur respectively. After their successful establishment, the technocrats of MPEDA were trained in the operational aspects and they subsequently propagated the technology to others. Such a system of technology transfer is the need of the day particularly in the case of mariculture where we are unable to move forward. Marine finfish culture technology, which has been successfully commercialized in other countries (in respect of similar species available in Indian waters) with very high rate of production, should also be imported so that the vast stretch of Indian sea coast, now lying barren, could be utilized for aquaculture.

Identification of Proper Entrepreneurs

Entrepreneurs play a very important role in the commercialization of technologies. An entrepreneur is the key person who has to invest in the project. He has to secure funds from a financing agency. He has to implement the project with dedication. He has to grasp the technology and develop a close idea of the manner in which the technology has to be applied for the success of his project. He must have the ability to face day to day technological, managerial or any other problems so as to ensure good results and profits. The entrepreneurial skill of the individual counts very much, specially if he has no previous experience in such projects. The entrepreneurs of Andhra Pradesh, Tamil Nadu, Punjab and Haryana have displayed very good entrepreneurship not only in adopting the technology transferred to them by the scientists but also in introducing innovations of their own.

1) **Transfer of Technology from Lab to Land** : Transfer of technology from lab to land plays a very important role in the ultimate success of a fisheries venture. Proper understanding between the giver and taker has to be established for successful implementation of a project.

2) **Consultancy** : Consultancy plays a vital role in the successful implementation of the project both before as well as after establishment of a project. There are always initial problems in running a new project and a good consultant can take care of all the problems. Once the workers involved in the implementation of the project are sufficiently trained, the role of consultants can be reduced. However, their technological advice should always be available to obviate any untoward incidents.

3) **Training and Extension** : Training and extension play a significant role in the commercialization of the technologies perfected by the scientists of Central and State Research Organisations, University departments engaged in fisheries work and others concerned. The main extension initiatives have to come from extension workers and officers in charge of FFDAs and BFDAs. Of late, a feeling is gaining ground that quality of extension work carried out by extension workers and officers at the district level is declining in quality due to some reason or the other. It has also been observed that there is no regular system of upgrading the skills of these officials in consonance with emerging technologies and scenario in the field which affects the quality of extension services provided to the farmers and entrepreneurs. It is necessary that regular short term programmes are organized by the research institutes for training these officials and nominees of State Fisheries Departments. These programmes can be taken up under a Central Scheme in collaboration with State Government concerned, as a new activity in the Plan. In some States, the FFDAs have been merged with State Fisheries Departments mostly due to financial problems. This has changed the basic concept and has affected the envisaged role of FFDAs. It is expedient that the merged FFDAs should be restored to their original FFDA status for their effective functioning. Another sector that has been neglected is in respect of training of Bank Officials who are supposed to appraise the loan applications and recommend sanctioning of loans. Unless the bank officials are aware of the possibilities in the sector it is very difficult for them to support applications for financing of fisheries projects, an activity that is not traditional. NABARD does organize such training programmes and workshops for officals from FFDA and Banks but the efforts need replication by other institutes. One more area that may help in popularizing these activities could be involvement of Bank and State Govt. officials in the Workshops and Seminars organized by various research institutes at which special sessions can be organised for discussing their problems so that action points could be identified. Such sessions could be held in the beginning of the programmes so that scientists can deliberate on the issues raised during the course of the programme and draw action points.

4) **Marketing** : Marketing plays a very important role in getting good returns from the commercialised activity. Financial viability of the projects depends on income generation. It is always necessary that an entrepreneur is aware about the market for his produce before starting the project. A tie-up in marketing either in the domestic market or export market or both can be a very assuring factor for the project instead of searching for the market afterwards. The tie-up should be for a longer period for establishing the viability of the project. This is more important when new products are launched in the market. Marketing problem can severely affect the project as has been observed in the case of mussel farming in Kerala, trout farming in Himachal, export of value-added products etc.

5) **Credit** : Credit is becoming the most

important factor influencing the commercialization of technologies due to rising cost of new technologies for increasing production. Credit at present is available from a number of financial institutions in addition to support from Government. The type of credit facility that could be extended for a fisheries project could be judged by the overwhelming response received from the shrimp farming sector during early 1990s,but technological, social, legal and pollution-related problems resulted in losses and huge over-dues of funds to the banking sector. It may be kept in mind that the banks are supposed to invest a part of their lending in priority sector every year and a number of avenues are available to them for investments including fisheries. They are more likely to invest in such ventures where the risks are less, the activity is more friendly and known to them and is well established. They cannot be compelled but could be persuaded to invest in fisheries activities if the activities are made user-friendly, less risky, more profitable and known to officials at the branch level. As such, all out efforts are required by all the agencies involved, in a well coordinated manner, to overcome the initial hitches in the implementation of the technologies by initiating a suitable policy and other necessary changes required.

Impact of Commercialization of Fisheries Technologies

Commercialization of any activity may have inpact on the overall economy of the country and also on other related areas. These effects can be both positive as well negative. So far as positive impacts are concerned, these are as follows:

1) *Food security* : The ultimate effect of commercialization of fisheries technologies is expected to increase fish production which will provide cheap protein rich food for the masses and increase the per capita availability of fish. This will help in feeding the growing population of India.

2) *Employment Generation* : The commercialization of fish production and other technologies can generate plenty of employment in rural areas as a new avenue and can help in reducing unemployment. In addition, it will also generate secondary employment opportunities in the subsidiary sector for providing inputs, processing, marketing, production of various implements required in the application of technologies etc.

3) *Utilization of Resources* : The country has vast unutilised resources in marine, inland and brackishwater sectors. Commercialization of various technologies and their implementations in the field will enable utilization of these unutilised resources.

4) *Improving Socio-Economic Conditions* : Most of the fish farmers are poor. Consequently, it is one of the objective of various governments to improve their socio-economic conditions so that they can be brought above the poverty line. Adoption of new technologies by these farmers will improve their socio-economic condition by augmenting their incomes.

5) *Increasing Export Earnings* : The end products of these activities i.e., fishes, crustaceans etc., have great demand not only in the domestic market but also in the international market. Exports of sea food from India have reached a level of over Rs.6000 crores in 2000-01 contributing over 4.3% of gross national exports and 16% of the agriculture exports. There are lot of avenues for increasing these exports, and contributing towards national economy by earning valuable foreign exchange.

The negative impacts of commercialization are outlined as follows:

1) *Conversion of Agriculture Lands* : One of the negative impacts of commercialization that has been seen in the field is the conversion of good agriculture lands into fish farms as fish farming is a more profitable and relatively less labour-intensive activity. This can be compared with shift from traditional agriculture to cash crops which gives better returns. One counteracting feature is that the country has vast extents of wastelands which cannot be used for any purpose other than fish production. It should be the endeavour of all the agencies involved in developmental activities to concentrate, in the first instance, for converting these lands for fish culture. Efforts at conversion of existing paddy/wheat fields into fish ponds may lead to problems connected with the availability of staple food items on the long run.

2) *Social Tensions* : The development of shrimp farming sector in the States of Tamil Nadu and Andhra Pradesh witnessed rising tensions between the farmers who have sold their lands to the new entrepreneurs, and those who were unwilling to sell their lands. In the State of Kerala there is always a conflict between the traditional fishermen and the mechanized boat owners on rights of fishing. Concrete steps are necessary to obviate these problems by analysing the social factors.

3) *Environmental problems*: Environmental pollution has become the enemy of any type of development. Earlier this was restricted to industries, water courses etc. The advent of shrimp farming has activated the environmental pollution lobby to direct their agitational approach at this activity without realizing that if the most sensitive fishes can survive in the environment in small ponds, discharge from these ponds could not have any harmful effect on the natural habitat in the sea or creeks unless the proportion of pollution is alarming.

In any case, one has to be cautious while planning for the development of a particular area, taking all the factors into account. Further, conversion of mangrove or ecologically sensitive areas for fisheriés development may have long term effect on the natural resources, and this has to be avoided.

4) *Conflicts between Common Users* : Water bodies or the unutilised governmental land are commonly used by all the people residing near them. Thus, when that area or the water body is leased to an individual for development a con-

flict will develop between the traditional users and the lessee and this affects the implementation of the project. There should be a clear policy for resolving such conflicts. Problems of this kind have been encountered in fish farming in State-owned rural ponds which are used for cattle washing, bathing and clothes washing, and conflicts of this kind could also happen in the event of a policy for utilization of coastal land adjacent to sea is introduced for culture and capture fishery development, navigation etc.

Conclusion: It may thus be observed that commercialization is a very complex process involving not only a number of agencies but also proper planning, identification of policy issues, and initiation of various measures, in addition to perfecting the technology in the field for application on a commercial scale and adopting a coordinated approach which is required for commercialization.

Vasudevan's Team in Myanmar

Hi-Line Aqua, India's leading aquaculture - consulting group, has extended its services to Mynamar in order to promote the use of microbial biotechnology in shrimp farming.

Dr S. Vasudevan and Mr. Simon Chelladurai of Hi-Line Aqua have been recently commissioned by Australia's International Animal Health Products (IAH) to present a technical seminar on the use of probiotics to Winners Brothers Co, which is one of their clients in Mynamar.

Winner Brother Co has already started operating a 200 million PL hatchery and 45ha growout culture system for black tiger shrimp near Yangon. So far, the farm has harvested 108 tons of shrimps in 21 ponds.

Winner Brothers have plans to start a totally integrated project including a feed mill and seafood processing plant. They have already acquired project sites to develop them including a 300ha shrimp farm. They also want to utilise the present fishmeal plant with an ongoing production capacity of one tonne per hour.

As an expert in microbiology and distributor of IAH's products in India, Vasudevan complemented the technical personnel of Winner Brothers on their knowledge on various aspects of microbial biotechnology and highlighted the use of probiotics on aquaculture.

According to Vasudevan, the success of microbial biotechnology in aquaculture depends on selecting right strains of live and beneficial microbes, multiplying them in huge numbers and effectively balancing their populations in shrimp ponds to control bacterial and viral diseases.

The microbial products, (probiotics), also help to bring down FCR, breakdown sludge and slime, and improving the overall health of shrimp, Vasudevan said.

Performance of fish in Duck-Fish Integrated Culture in Rain - fed Rice Farming Areas

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In the integrated farming systems, fresh livestock manure or compost is directly used to increase the natural food of fish. The livestock is confined either over the fishpond margins or in a nearby area, with wastes dropping continuously into the ponds.

The system of fish-cum-duck farming is very popular in countries like China, Malaysia, Thailand etc. This integrated farming system is pursued following two types of practices i.e., open system and closed system. In open system of integration, the ducks are allowed to go into the pond for a certain period of time every day whereas in the closed system the duck house or cages are built on the pond embankment or over the pond margins so that droppings can go directly into the pond. By adopting this system, energy losses as a result of transportation is avoided (NACA, 1989). The closed system of integration is more complex in comparison to open system of farming, and it can be very much successful in well-managed large farms. The open system is followed in the experiment conducted by the authors, and this is found suitable for small individual ponds.

Livestock production and its potential for integration with fish culture is linked to overall economic development. There is good potential for Fish-cum-Duck Culture in the rain fed areas of Jharkhand, West Bengal and Chattisgarh States. The technology of integrated farming can increase the average fish production from a range of 200-500 kg/ha to a range of 1000-4000 kg/ha from seasonal, long seasonal and perennial ponds (Singh, 1993). This system of farming is not gaining popularity either because of heavy investment or may be because of poor technology packages, which are not economically viable (Little and Edwards, 1999).

Keeping these aspects in view, a pilot project on fish culture in rain fed rice-farming area was implemented in the tribal belts of present Jharkhand which was part of erstwhile Bihar State (referred to hereinafter as Bihar),in West Bengal and in with present Chattishgarh part of Madhya Pradesh State (hereinafter referred to as Madhya pradesh) by (1) Faculty of Veterinary Sciences and Animal Husbandry of Birsa Agricultural University, Ranchi (BAU), (2) Faculty of Fisheries, West Bengal University of Animal and Fishery Sciences, Mohanpur (WBUAFS) in West Bengal, and (3) Department of Fisheries, Indira Gandhi Agricultural University, Raipur (IGAU) respectively. The project was designed to be conducted in selected ponds in their natural conditions. Altogether nine ponds owned by farmers, three in each of the States were selected. The details are given in Table 1. As may be seen there from, in Bihar one perennial pond of 0.06 ha, and two seasonal ponds of 0.6 and 0.9 ha (Total 0.21 ha) were chosen. In West Bengal also one perennial (0.60 ha) and two seasonal ponds 0.09 and 0.05 ha (Total 0.74 ha) were selected. In Madhya pradesh one perennial pond with an extent of 1.0 ha, and two more perennial ponds with an extent of 0.6 ha each were chosen (total 2.2 ha). In other words, in all 3.15 ha were brought under the project. The ponds were stocked with *Catla catla, Labeo rohita, Cirrhinus mrigala, Cyprinus carpio, Ctenopharyngodon idella, Hypophthalmichthys molitrix* and *Aristichtys nobilis* @ 25,000 fry/ha or @ 10,000 fingerlings /ha at a ratio 2:2:1:2:2:1:1:1. At all the centres Khaki Campbell variety (crosses of fawn and white runner and Mallard ducks) of ducks and also some locally available varieties were integrated. They were stocked at @ 250 no./ha. They were provided supplementary feed of rice and kitchen wastes available in the concerned farmer's house at night @ 100g/duck/day. The monthly weight gains of fish and ducks were recorded. The physico-chemical and biological parameters of pond waters were analysed as per the standard method (APHA, 1971).

As earlier mentioned, three ponds were selected in each of the States by the respective universities/faculties/departments. The selected farmers were from Ranchi district (BAU centre), Midnapore district (WBUFS centre) and Durg district (IGAU centre). The presented observations were made from July 1999 to June 2000. The details are furnished in Table 1.

Results and Discussion

Fish ponds provide an excellent and essentially disease free environment for ducks (Kumar and Ayyappan, 1998). Ducks consume tadpoles, juveniles of frog, and dragon fly larvae, thereby eradicating many predators of fishes. Furthermore, the protein content in natural food organisms of the pond consumed by duck is high. Therefore the duck rearing in fish ponds saves the cost of protein substantially in duck feeds and gives more eggs in comparison to ducks, which are not allowed in fish ponds (Sharma, 2001).

Fishes were stocked in the project ponds in the month of September 1999. The Indian major carps and exotic carps were chosen for culture because polyculture of carp is considered as the best in waste-fed ponds. The input levels were kept lower, taking into account sensitivity of stocked fishes to dissolved oxygen content, which could go down if

inputs werre excessive. The fish production achieved from ponds was in the range of 888.88 kg/ha, as compared to 555 kg/ha to 2750 kg/ha of production in the previous year. Among the species *Cyprinus carpio* grew upto 4-5 kg, whereas others i.e., *C.catla* grew upto 400g, *L.rohita* 500g, *C.mrigala* 234g, *H.molitrix* 298g, *C.idella* 325g, in 8-10 months. The particulars are given in Table 1.

At BAU Centre, the day old Khaki Campbell ducks were procured from Central Duck Breeding Farm (ICAR), Bangalore. It was planned to maintain and grow them for 2 months at RVC, Kanke, Ranchi, before introduction into farmer's ponds, for the reason that ducklings would move to pond only after the age of 2 months. The procured ducklings, as it happened, suffered from Amphalitis. In spite of all the efforts, the mortality was very high and only 40 ducklings could survive. These were distributed to the farmers to keep them in open system of farming. The mortality continued, reaching a level of about 95%. At WBUAFS and IGAU centres too, the ducklings, which were procured from their State Poultry and Duckery Farms, mortality occured, but to the extent of 50% and 38% respectively. To make up the required number, some 2 months old local variety of birds were added afterwards.

At BAU Centre a total of 54 ducklings were distributed which have shown an average growth rate of 129.4 g/m to 135.7 g/m (Khaki campbell) and 102 g/m to 142 g/m (Local). The egg laying started in March, 2000 and lasted till 31st June, 2000. 18 of them laid 950 eggs and there was a production of 26 ducklings from 45 fertilized eggs. At WBUAFS centre, out of the 241 ducks supplied, 174 eggs were laid by 18 of them, and at IGAU centre, out of 241 ducks supplied, 2155 eggs were laid by 41 of them in the same period. The different levels of egg production at the three centres might be due to different management patterns followed by the farmers. It was observed that the layers needed more animal protein during the laying period, which was very long. So it was noted that ponds having more aquatic animals were needed. It was also noted that ducks infested with parasites also laid a lower number of eggs (Edwards *et al.*, 1996).

The ducks were kept away from the pond during nights and allowed to enter the ponds during daytime only. So the farmers were advised to add the dropping of faecal matter from the duck house to their ponds during daytime. Over-loading of duck manure in the ponds was avoided during winter season by not adding duck house manure into fish ponds. Fish mortality may occur occasionally due to a continued build up of waste during the winter season, causing a subsequent bacterial and plankton bloom as temperature rises, finally resulting in depletion of oxygen from water (Sin, 1980).

The duck manure has a pronounced effect on natural feed production, i.e., plankton production in contrast to ruminant manure, which inhibits phytoplankton growth. Ruminant manure has relatively less soluble N and P input (6% at total N and 35% of total P causing marked reduction of light penetration into the pond column (Shevgoor *et al.*, 1994). In contrast to the greenish duck manured ponds, addition of buffalo manure caused a high oxygen demand, which may also have retarded fish growth.

The application of duck manure and grazing by ducks in the ponds are found to have finally improved the physico-chemical parameters of soil and water. The soil parameters like pH, organic carbon percentage, phosphorus and potassium had shown a favourable increase. The particulars of these parameters are given in Table 2.

The physico-chemical and biological parameters of pond water like pH, alkalinity, dissolved oxygen, free carbon dioxide, conductivity, $KMnO_4$ consumption and plankton concentration were in a favourable range during the experimental period. The particulars are given in Table 3. The detritus formed by duck excreta at the pond bottom would serve as substrate for microorganisms as well as food for zooplankton and fish. Microbial community in detritus is known to provide essential nutritional requirements to the fish feeding on it (Newell, 1980 Schroeder, 1980). The increased level of plankton in ponds manured with duck droppings supports the above hypothesis.

The change in different parameters of soil and water indicates that ponds are becoming more productive. Almost all the selected parameters of soil and water have shown increased productivity trends. There was fluctuation in dissolved oxygen concentration (4 ppm to 3 ppm) and free carbon dioxide concentration (0 to 20.6 ppm). These may be due to higher utilisation of oxygen for decomposition of organic manure or consumption by the phytoplankton and other aquatic organisms during those hours. Micro bacteria and phytoplankton consume about 50% of dissolved oxygen concentration (NACA 1989). The increase in free carbon dioxide concentration may be due to decomposition of organic matter. The high dissolved oxygen concentration increases the feed intake, which ultimately results in good fish growth.

The economics of fish-cum-duck farming have been studied on the basis of sale proceeds and market value of ducks (unsold). These revealed that the farmers have received a gross income of Rs.989/ha to Rs.68, 828/ha. The returns on investment per rupee had a range of Rs.1.45 to Rs. 16.17. The detailed information on economics of fish-cum-duck culture are given in Table 4. The variation is very high due to total mortality or poaching of fish in some cases.

The present experiment revealed that fish-cum-duck farming could increase fish production and provide an additional income and employment to the rural people.

The pond silt can be better utilised in rice fields as it will increase the production. The present findings indicate that there is still scope for on-farm participatory research to develop a resource-based technology.

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Table 1 - Detailed Information about Fish Farmer, Fish Growth, Duck Growth and -- Production

Code, Name & address of Fish Farmer	Pond area & seasonality	No. of ducks provided	Initial av.wt. of ducks (g)	Final wt. of ducks(g)	No. of eggs & ducking received	Last yr. Fish production	No. of seed stocked	Fish harvested (kg/ha)	Growth (Sp. Wise)
J 1/99 adan Mahto Vill. Kakai Ormanjhi Ranchi	0.06 ha Perennial	15 KC=12 Local=3	KC=250 Local=400	KC=1100 Local=1400	350 (7)	40kg @666 kg/ha	1500(fry) *C.catla=500* *L.rohita=500* *C.carpoi=500*	Poaching	-
J 2/99 Bhuneshwar Bhandari Vill. Hindivilli, Ormanjhi, Ranchi	0.09 ha Seasonal	23 KC=7 Local=16	KC=250 Local=400	KC=1200 Local=1300	500 (7)	50 kg @ 555 kg/ha	2500 (fry) *C.catla=1000* *L.rohita=500* *C.carpoi=500* *C.idella=250*	80 (888.8)	*C.catla=400-500 g* *C.carpoi=250-300 g*
J 3/99 Sukhram Bediya Vill. Vijang, Ormanjhi Ranchi	0.06 ha Seasonal	16 KC=8 Local=8	KC=250 Local=400	KC=Nil Local=1300	100 (12)	50 kg @ 833 kg/ha	1500(fry) *C.catla=1000* *L.rohita=500* *C.carpoi=500*	200 (3333.3)	*C.catla=250-300 g* *L.rohita=400-500 g* *C.carpoi=4-5 kg*
WB 1/99 Pranab Patnayak Vill. Uchitpur, Sabong, Midnapore	0.6 ha Perennial	KC=198	220-520 g	1290	84	480 kg @ 800 kg/ha	6000 (fingerlings) *C.catla=1500* *L.rohita=1500* *C.mrigala=500* *C.carpoi=1500* *C.idella=500* *H.molitrix=500*	1250 (2083)	*C.catla=395g* *L.rohita=186g* *C.mrigala=210g* *C.carpoi=225g* *C.idella=325g* *H.molitrix=260g*
WB 2/99 Dinesh Adhikari Vill. Barua, P.O. Abas, Midnapore	0.09 ha seasonal	KC=28	215-380 g	1175	65	60 kg @ 667 kg/ha	900 (fingerlings) *C.catla=300* *L.rohita=200* *C.mrigala=100* *C.idella=200* *H.molitrix=100*	80 (8888)	*C.catla=325g* *L.rohita=195g* *C.mrigala=145g* *C.idella=70g* *H.molitrix=291g*
WB 2/99 Nilima Maity Vill. Barua, P.O.Abas Midnapore	0.05 Seasonal	KC=15	220-385 g	1161	25	35 kg @ 700 kg/ha	500 (fingerlings) *C.catla=200* *L.rohita=200* *C.mrigala=100*	NA	NA
C 1/99 Sanendra Bajnel Vill. Kuruddih, Durg.	1.0 ha Perennial	KC=56*	1250 g	1750 g	1062	2500 @ 2500 kg/ha	6000 (fingerlings) *C.catla=2400* *L.rohita=1200* *C.mrigala=1200* *C.carpio=1200*	2700 (2700)	*C.catla=881g* *L.rohita=266g* *C.mrigala=283g* *C.carpoi=885 g*
C 2/99 Narsingh Yadava & Santosh Thakur Vill. Kuruddih Durg	0.6 ha Perennial	KC=30*	1250 g	1700 g	379	900 kg @ 1500 kg/ha	4000 (fingerlings) *A.nobilis=1000* *C.catla=1000* *L.rohita=1500* *C.mrigala=500*	1100 (1833.33)	*C.catla=232g* *L.rohita=237g* *C.mrigala=221g* *C.carpio=255g*
C 3/99 Swati Phansalkar Vill. Jheet Durg.	0.6 ha Perennial	KC=40*	1250g	1712g	714	1650kg @ 2750 kg/ha	600 (fingerlings) C.carpio=1500 C.catla=1500 L.rohita=2500 C.Mrigala=500	1800 (3000)	C.catla=308g L.rohita=231g C.mrigala=234g C.carpio=282g

KC= *Khaki Campbell*

* The required numbersof Ducks were fulfilled by the other ducks came for grazing into the ponds

Table 2 : Physico-chemical Parameters of Pond Soil

Code of Fish Farmer	Before Starting the Experiment				During Experiment			
	pH	Organic Corbon(%)	Phosphorus (mg/100g)	Potassium (mg/100g)	pH	Organic Carbon(%)	Phorphorus (mg/100g)	Potassium (mg/100g)
J 1/99	5.6	0.40	1.12	7.6	6.5	0.63	1.75	8.2
J 2/99	5.5	0.35	1.21	6.7	6.4	0.62	1.57	8.46
J 3/99	5.5	0.40	1.22	7.41	6.4	0.70	1.57	8.0
WB 1/99	6.9	-	-	-	6.7	0.56	-	-
WB 2/99	6.8	-	-	-	6.9	0.58	-	-
WB 3/99	7.0	-	-	-	6.4	0.48	-	-
C 1/99	6.65	1.3	44.8	0.12	7.32	1.32	0.42	32.2
C 2/99	6.9	0.724	26.13	0.10	7.81	1.15	0.28	28.5
C 3/99	8.26	0.517	29.86	0.04	8.54	1.02	0.34	30.6

Table 3 : Physico-chemical and biological Parameters of Pond Water

Code of Fish Farmers	Before Starting the Experiment						During Experiment							
	Plank Ton (ml/50l)	pH	Alkal inity (ppm)	D.O (ppm)	Free CO_2 (ppm)	Conduct ivity (umgo/cm)	$KmnO_4$ consum ption (ppm)	Palnk-ton (ml/50L)	pH	Alkal-inity (ppm)	D.O (ppm)	Free CO_2 (ppm)	Conduct ivity (umbo/cm)	$KmnO_4$ consumption (ppm)
J 1/99	0.5	7	48	4	10	15.24	1	1	7.5	340	10	2	70.64	4
J 2/99	0.5	7	46	5	8	87.2	1.6	4	7.5	140	4	4	69.25	3.6
J 3/99	0.5	7	50	5	8	67.9	1.4	5	7.5	240	10	NIL	69.0	4
WB 1/99	-	6.9	80	6.6	4	-	-	4.5	7.2	190	6.60	8.8	-	16.4
WB 2/99	-	6.8	78	6.4	7	-	-	1.2	7.6	40.8	6.4	20.6	-	15.8
WB 3/99	-	6.5	72	5.6	5	-	-	2.4	6.9	136	5.6	14.0	-	16.0
C 1/99	>0.5	8.01	183	5.0	2.5	256	-	0.8	8.01	198	7.38	2.50	351	-
C 2/99	>0.5	7.19	121	4.4	7.0	74	-	0.6	7.85	151	8.64	10.98	399	-
C 3/99	0.5	7.32	116	13.0	7.0	102	-	0.7	8.41	138	13	7.0	385	-

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References

EDWARDS. P., DEMAINE, H., TAYLOR. N. INNES and TURONGRUANG, D. (1996) Sustainable aquaculture for small scale farmers: Need for a balanced Model. *Outlook on Agriculture*, 25 (1): 19.

JHINGRAN, V.G. and SHARMA, B.K. (1980) Integrated Livestock Farming in India (Ed.R.S.V.Pullin and Z.I.I. Shehadeh). Proceedings of the ICLARM-SEARCA Conference on Integrated Agriculture Farming System, ICLARM Conference Proceedings, Manila, August, 1979.pp 135.ICLARM-SEARCA Manila. Philippines.

KUMAR, KULDEEP and AYYAPPAN, S. (1988). Current practices in Integrated Aquaculture. Central Institute of Freshwater Aquaculture (ICAR, Kausalyganga, Bhubaneshwar-751002. Working Paper-2.

LITTLE, DAVID C. and EDWARDS, PETER (1999) Alternative strategies for Livestock-fish Integration with emphasis on Asia. *Ambio*, **28**(2) 188.

NACA (1989) Integrated Fish farming in China, NACA Technical Manual. Thailand.

NEWELL, R. (1970) The role of detritus in the nutrition of two marine deposits feeders. *Proc. Zool. Soc.* London. 144.pp.25

SCHROEDER, G.L. (1980) Fish Farming in manure loaded ponds- In R.S.V.Pulin and Zain. H.Shchadeh (Ed) Proc. ICLARM-SEARCH Cong. Integrated. Agr. Aqua. Fmg. Systems, Manila, Philippines, pp.73.

SHARMA, R.K. (2001) Studies on performance of duck cum fish under integrated systems of farming. M.V.Sc. Thesis, Ranchi Veterinary College, Kanke, Ranchi.

SHEVGOOR, L.Kund, H.C.E and Edward, P. (1994) An assessment of the role of Buffalo manure for culture of Tilapia. *Aquaculture*, **12** (1-2): 107.

SIN, A.W.C. (1980) Integrated Animal-Fish Husbandry systems in Hongkong with special case studies on Duck-Fish and Goose-fish system. In proceedings of the ICLARM-SEARCA Conference on Integrated Agriculture Aquaculture Farming system, Manila, Philippines, 6-9 Aug. 1979 (eds. Pullin, R.S.V., Shehadeh, Z.H.). International Centre for living Aquatic Resources Management, Manila and the South-East Asian Centre for graduate study and Research in Agriculture, College, Los Banos, Laguna, Philippines, pp.113.

SINGH, A.K. (1993) Fish-cum-Pig Farming: Boon for Tribal Areas. *Fishing Chimes*, **12** (10):47.

Table 4 : Economics of Fish-cum-Duck Farming

Farmers code / Description	J 1/99	J 2/99	J 3/99	WB 1/99	WB 2/99	WB 3/99	C 1/99	C 2/99	C 3/99
Duration (in Months)	8	8	8	8	8	8	8	8	8
A. INPUT COST Cost of Fingerlings/fly	1500 Rs. 202.50	2250 Rs. 303.75	1500 Rs. 202.50	6000* Rs.7,200.00	900* Rs. 1,000.00	500* 600	6000* Rs. 1,200	4000* 800	6000* Rs. 1,200
Cost of Duck @ Rs. 50/duck	15 Rs. 750.00	23 Rs. 1,150.00	16 Rs. 800.00	198 Rs. 4,950.00	28 Rs. 700	15 Rs. 375.00	56 Rs. 2920.00	30 Rs. 2,100.00	408 2,800.00
Cost of lime	Rs. 150.00	Rs.225.00	Rs. 150.00	Rs. 372.00	Rs. 300.00	Rs. 300.00	-	-	-
Netting charges	Rs. 300.00	Rs. 300.00	Rs. 300.00	-	-	-	Rs. 500.00	Rs. 300.00	Rs. 300.00
Sub-Total (Rs.) (A)	Rs. 1,402.50	Rs. 1978.75	Rs. 1,452.50	Rs. 12,522.00	Rs. 2,181.0-0	Rs. 1,331.25	Rs. 4,620.00	Rs. 3,200.00	Rs. 4,300.00
B.INCOME Fish @ Rs. 30/kg At two cnetres and @ Rs. 25/kg at IGAU center	Poaching	Rs. 2,400.00 80 kg	Rs. 6,000.00 200 kg	Rs. 37,500.00 1250 kg	Rs. 2,400.00 80 kg	Poaching	Rs. 67,500.00 2700 kg	Rs. 27,500.00 1800 kg	Rs. 45,000.00 1800 kg
Duck eggs @ Rs. 1.25 – 3/egg	350 eggs Rs. 875.00	500 eggs Rs. 1,500.00	100 eggs Rs. 300.00	90 eggs Rs. 180.00	70 eggs Rs. 140.00	25 eggs Rs. 50.00	1062 eggs Rs. 1,328.00	379 eggs Rs. 474.00	714 eggs Rs. 893.00
Value duck @ 60/kg	22.8 kg Rs. 1,368.00	11.6 kg Rs. 696.00	5 kg Rs. 300.00	46.8 kg Rs. 2,106.00	14 kg Rs. 630.00	6.5 kg Rs. 292.00	98 kg Rs. 5,880.00	51 kg Rs. 3,060.00	68.4 kg Rs. 4,104.00
Ducklings @ Rs.50/D	-	7 Rs. 350.00	12 Rs. 600.00	-	-	-	-	-	-
Sub-total of B (Rs.)	Rs. 2,243.00	Rs. 4,946.00	Rs. 7,200.00	Rs. 40,116.00	Rs. 3,170.00	Rs. 342.00	Rs. 74,708.00	Rs. 31,034.00	Rs. 49,997.00
C.PROFIT (B-A) Rs.	Rs. 840.00	Rs. 2,697.25	Rs. 5,747.50	Rs. 27,596.00	Rs. 989.00	Rs. 988.75	Rs. 70,088.00	Rs. 27,834.00	Rs.45,697.00
Profit (Rs./ha)	Rs. 14,000.00	Rs. 29,969.00	Rs. 95,783.00	Rs. 45,993.00	Rs. 10,988.00	-	Rs. 70.088.00	Rs. 46.390.00	Rs. 76,161.00
Fish Production/ha (kg/ha)	-	888.8	3333.3	2083	888.8	-	2700	1833.33	3000
Return on per Rs. invested	1.59	2.49	4.95	3.20	1.45	-	16.17	9.6	11.62

* Fingerlings

Seasonal Variations in Fish Seed Trade at Naihati Seed Market, North 24 Parganas, West Bengal

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Rahara, West Bengal

West Bengal occupies a pioneering place in the field of fish seed production. The demand of fish seed continues to be high, in view of rapid expansion of fish culture activity in the State. Fish seed being an important input for culture fish production, it is essential that quality fish seed is made available to the fish-farmers.

Rahaman (1949) reported on the fish fry trade in Bengal. Ganguly and Mitra (1957) described the fish fry collection centres, method of fry collection and system of fry trade along the river Bhagirathi. Mitra (1960-61) described fish fry trade in Dhulian area of district Murshidabad (West Bengal). Subsequently, he also reported on the collection of spawn, the nature of trade thereof and water parameters of the river Hooghly (Mitra, 1964). Ghosh (1984) gave a note on carp seed trade at Kakdwip, South 24 Parganas (West Bengal). He gave information on the trade centres, mode of arrival of fish seed, method of sale and purchase, and species composition with quantum of seed of each species. Paul (1986) reported on the sources of major carp seed supply and identified some factors influencing economics of seed production and marketing. Sengupta and Sen (1986) provided a valuable account of trend of seed production in different districts of West Bengal including particulars in respect of mode of transport and business in fish seed. The authors also outlined the vast scope for development of fish seed industry in the background of the unique ecological conditions and seed demand potentialities prevailing in the State.

North 24 Parganas district has a pride of place among the various districts of West Bengal in respect of fish seed trade, for the reason that the seed production centres are located close to Jorabattala Fish Seed Market, Naihati which is about 30 km. away north of Kolkata. Further, this market is about 2 km. far from Naihati Railway Station which is situated at the east side of Barrackpore-Kalyani high way.

This communication attempts to evaluate the magnitude of fish seed trading activity in this part of North 24 Parganas district while also providing an estimation of seasonal abundance of seed arrivals of different species at the market. Economics of fish seed trading too have been assessed.

Methodology

The data on fish seeds were collected once in every week throughout the study period, through enquiry from randomly selected seed traders carrying on seed business in the market. The trading commences in the market daily from 4 a.m and continues up to 7 p.m. About 125 traders participate daily in the business during rainy season. In the Tables and Graphs in this paper, the winter season data presented were gathered in November 1997 and rainy season data in July 1998. In winter (Nov 1997) there was sluggish demand and consequently expected drop in the price of fish seed.

In order to find out the magnitude of seed trading activity at the start of fish culture during the rainy season, the set of data collected in July 1998 was used. This set of data was characterized by availability of fish seed of various species and their different size ranges. The prices of seed of fishes were also found higher than those available in the winter season.

Observations

Source of Fish Seed: The fish seed converging into the market comes mainly (80%) from different local hatcheries such as Ghosh's and Biswas's Hatcheries of Naihati and Pal's Hatchery of Kanchrapara, etc. Only a small quantity (20%) of seed harvested from natural sources reaches the market. The traders mostly reside in the nearby localities such as Madral, Garifa, Jagaddal, Atpur, Halisahar, Kanchra-para etc. Some traders even come from Gayeshpur of district Nadia and Chinsura, Chandanagar, and Bandel of district Hooghly. It is estimated that in the month of November about 45-50 traders conduct their business daily in the market. The number of traders increases up to 125-130 during the month of August.

Seed Trading Pattern: The farmers produce carp seed by hypophysation technique. They bring the seed into the market either directly or through small traders. The traders sell the seed to the customers either on advance order or by offering a price fixed after some bargaining. The traders give preference to the customers who purchase seed on cash payment. As the next alternative, the traders sell seed to their known customers with an arrangement to pay the cost on instalments. The traders occupy about 0.45 ha. area of the market in rows with their collections in aluminium containers, called *hundies* and weighing equipments. The carp seed is kept alive in *hundies* by agitation of water by hands. The seed (fry) of carps is not fed during trading. However, those of African catfish *(Clarias gariepinus)* are fed with boiled egg yolk to discourage cannibalism. (Fig. 7). The trading activity in the market is regulated by a committee of traders known as "Matsya Bazaar Samiti" and its office is situated adjacent to the market. The traders pay a sub-

scription of Rs.1.00 per day to the *Samiti* and in consideration of this they get some basic amenities in the market area. The fingerlings are sold by weight and fry in volume, measured using a standard container known as *Bati*, which holds a volume of 250 ml and about 50,000-60,000 spawn of carps and 1,000-1,500 nos. of early carp fry. *Magur* fish seed is sold by counting (Fig. 8).

Mode of Transporrt of Seed

An aluminium container known as *hundi* of 30-50 litre capacity is used to transport seeds. Two such *hundies* are suspended on either side of a split bamboo sling which is carried on shoulder. Such seed-filled *hundies* are covered by a piece of cloth *(gamchha)* around the mouth of the containers during transport to prevent spillage of seed to the outside during water splashing (Fig. 5). Water in *hundies* gets agitated during water splashing and jerky movements of the bamboo sling while being carried. When the carrying person stops for rest, he agitates the water in hundies by hand. Rickshaw vans are also used as a popular means of transport of seed both by local traders and purchasers (Fig. 6). Such vans can carry four *hundies* at a time. Big farm owners or a group of farmers coming from a long distance prefer to reach the market by trucks or Matador vans. After purchasing the seed they return back by the same vehicles along with seed *hundies*. Seed is also despatched to the farmers belonging to other States like Bihar, Orissa, Uttar Pradesh, Chhattisgarh etc, packed in water-filled and oxygenated polyethylene bag and placed in emptied oil containers improvised with fully-covered lids. The seed of cat fish is also transported in the same way as carp seed. Local farmers however prefer head-load mode of transport as it is economical.

Table 1: Size Groups of Fish Seeds and their Abundance (%) in Rainy Season

Species	*Large (30%)*		*Small (40%)*		*Tiny (30%)*	
	Size (m m.)	*%*	*Size (m m.)*	*%*	*Size (m m.)*	*%*
1. Big head	60-70	13	30-40	10	10-20	4
			25-30	5		
2. Grass carp	50-60	1	30-40	3	-	-
3. Common carp	40-50	1	25-30	2	10-15	3
4. Silver carp	50-60	1	25-30	1	10-20	3
5. Rohu	60-70	2	30-40	3	10-20	4
	50-60	1	25-30	2	8-10	1
6. Catla	60-70	2	30-40	3	10-20	4
	45-60	1	25-30	2	8-10	2
7. Punti	30-40	1	20-30	2	10-20	1
8. Bata	30-40	1	20-30	2	10-20	1
9. Cat fish	100-120	3	30-40	2	10-20	5
	60-70	3			5-10	5

Table 2: Size Groups of Fish Seeds and their Abundance (%) in Winter Season

Species	*Large (20%)*		*Small (60%)*		*Tiny (20%)*	
	Size (m m.)	*%*	*Size (m m.)*	*%*	*Size (m m.)*	*%*
1. Big head	60-70	10	30-40	5	10-20	5
			20-30	10		
2. Grass carp	50-60	1	20-30	10	-	-
3. Common carp	20-30	1	15-20	10	-	-
4. Cat fish	80-100	4	20-30	10	5-15	5
	60-70	4	30-40	10	15-20	10
			40-50	5		

Economics of Fish Seed Trading

Apart from abundant availability of major carp spawn, fry and fingerlings during rainy season, seed of other economically viable fish species is available for trading in substantial quantities in winter as well as in part of rainy season. These include seed of common carp (*Cyprinus carpio*), Big head (*Aristichthys nobilis*), Grass carp (*Ctenopharyngodon fossilis*) and African catfish (*Clarias gariepinus*). The estimated quantities of fish seed in both the seasons is shown in Fig 1. Minor carp seed is also traded in Naihati market comprising about 10% of the total carp seed business. *Puntius javanicus* (punti) and *Labeo bata* (bata) form the major species of minor carp seed transacted. The detailed breakup of composition of carp seed available in the market during rainy season along with catfish seed is shown in Fig. 2.

Jorabattala Fish Seed Market of Naihati has emerged as a focal point for trading of catfish seed particularly of exotic African catfish. This species is a recent addition to aquaculture in West Bengal. It came to the State through an undocumented route but widely believed to have come from Bangladesh. Most farmers have an inclination for catfish farming with the aim of quickly earning substantial profits through culture of African catfish which is undertaken only for a short duration. (2-3 months). Because of year round steady demand of seed of this species, the seed is made available in the market in both rainy and winter seasons with a little fluctuation of price (Fig.3).

The comparative prices of different

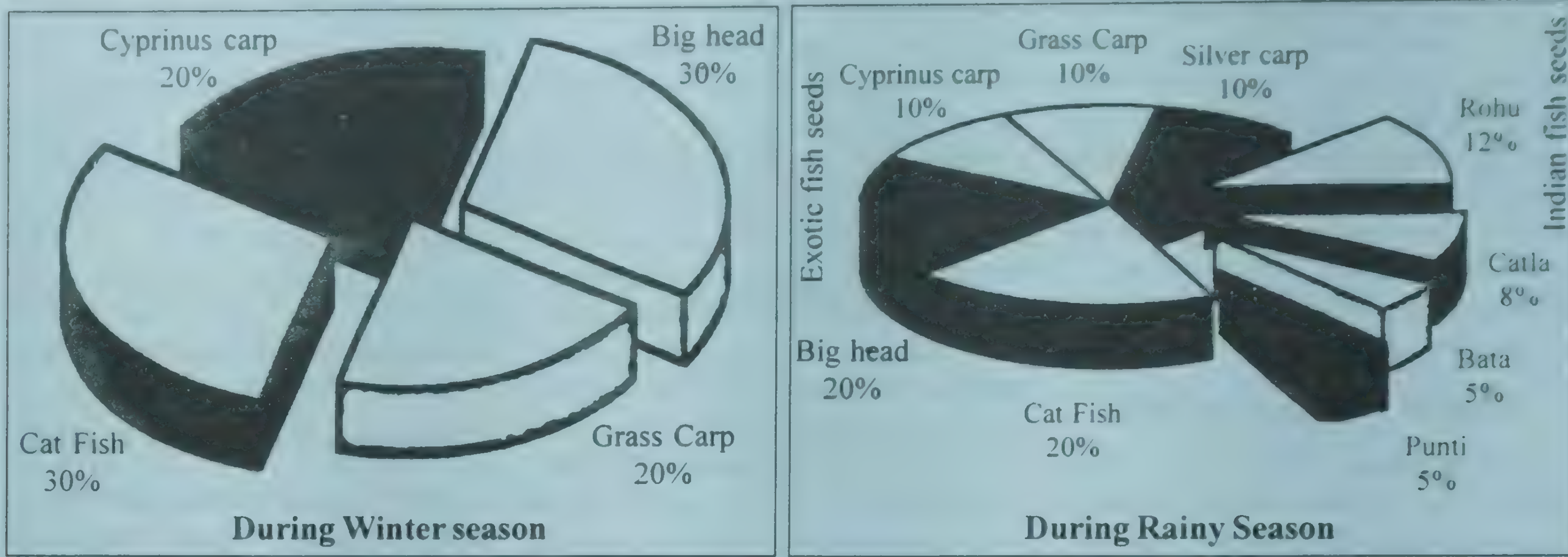


Fig 1 : Abundance of Fish Seed in two seasons at Naihati Seed Market

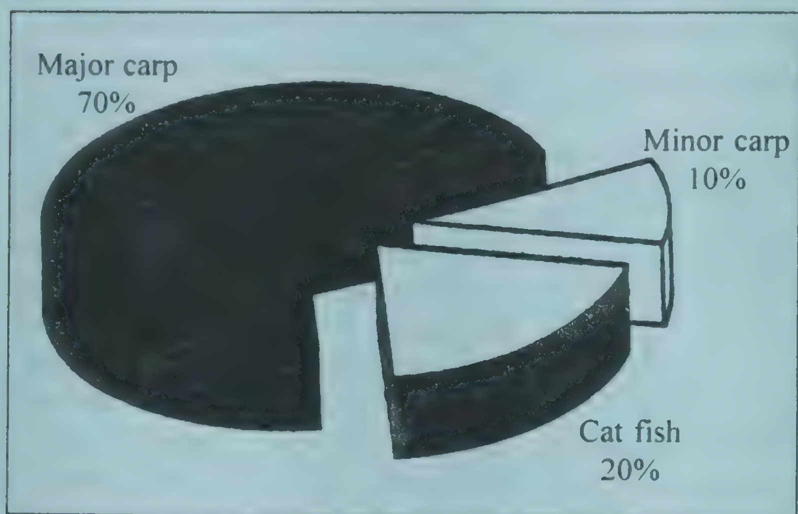


Fig 2: The Percentage of Cat Fish, Major Carp, Minor Carp seeds during Rainy Season at Naihati Fish Seed Market.

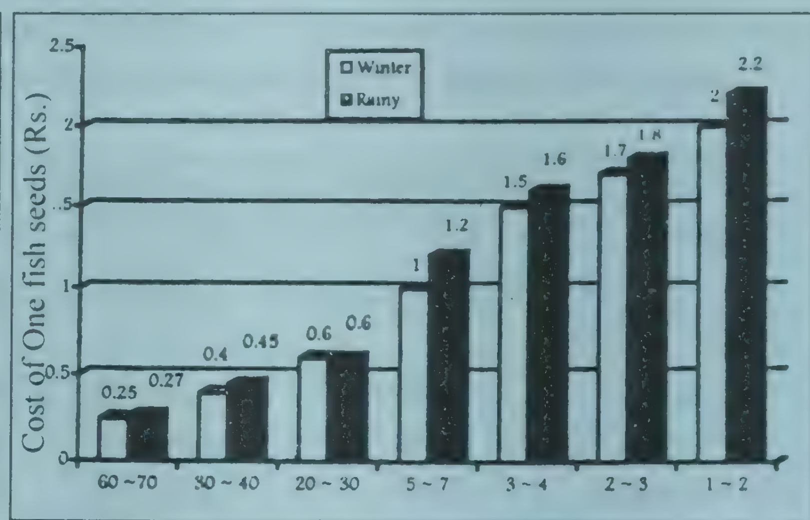


Fig 3: Cost of Cat fish seeds in two seasons.

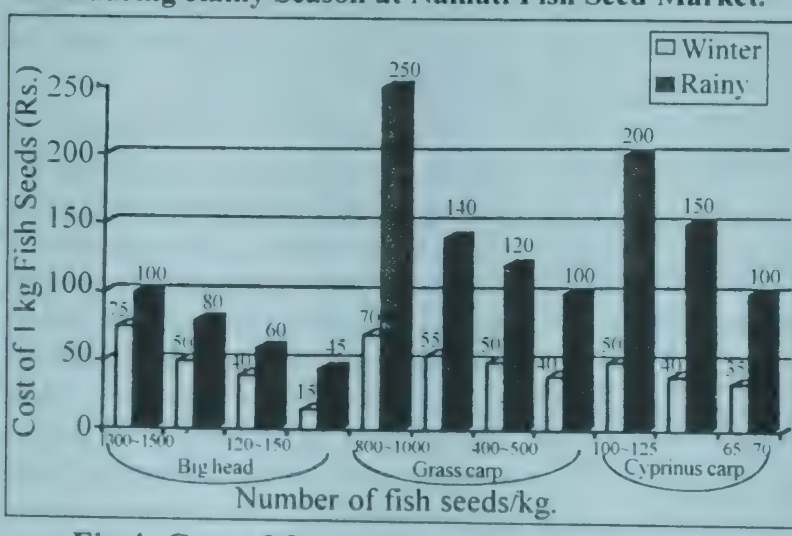


Fig 4: Cost of Carp fish seeds in two seasons

sized fish seed available in both rainy and winter seasons, are depicted in Fig.4. It may be noted that the prices rate of all species of carps irrespective of size ranges are very high in rainy season.

The traders usually categorise carp seed into three grades depending upon the size. These are large (~*mota*), small (~*patla*) and tiny (~*dana*) grades. The price is determined on the basis of such gradation. The details of the size groups of seed and their abundance in rainy season are presented in Table-1. The respective percentage of each grade out of total quantity of seed traded in the market in winter season is depicted in Table-2.

Discussion

After the path-breaking success of induced breeding of major carps in mid-fifties majority of the important food fishes are now successfuly bred by induced breeding. The success has helped to produce millions of seeds of valuable major carps for culture. As a result the fish market usually teems with major carp fish seed specially during the rainy reason. It is significant that West Bengal now accounts for nearly 75% of the seed requirement of the country (Chattopadhyay, 1986).

Fish seed market in Naihati is the centre of seed traffic of at least nine species of food fishes during the rainy season. Even in the winter months there is heavy trading in the seed of African catfish. Besides this, the seed of big head, grass carp and common carp are traded in at least two categories in the winter months. It has been documented that significant percentage (about 30%) of the seeds is also diverted outside the State, as has been reported earlier by

Fig 5: Water is poured into the 'hundi' in which fish seeds require more water. It is understood by practical experience

Fig 6: Fish seeds inside the 'hundies' are ready to transport. By jerking the van aeration is done artificially.

Fig 7: Magur seeds are counted for selling according to their sizes. Hen's eggs are used as their food.

Fig 8: After counting, Magur seed from a 'hundi' is kept into a plastic jar which will be transported from this seed market

Sengupta and Sen (1986). The most popular size of seed traded in this market is the small category (*patla*) ranging in size from 25-40 mm., which is an advanced fry stage of most carp species.

The fish seed trading system in this market is well organised. In fact, the market network provides ample opportunities to generate employment influencing rural economy of this region.

Brookstock management system adopted by the local fish seed suppliers requires a close study, for the reason that inbreeding depression has already set in and reports of poor growth of fishes are not uncommon.

The seed trade at Naihati Market throws out another important issue: whether widespread aquafarming of *Charias gariepinus*, the exotic catfish shall be allowed at the expense of extermination of indigenous weed fishes which are avidly consumed by this exotic catfish. There is an urgent need to evolve a compromise between protection of weed fish and culture of the exotic species keeping the economics of living of small farmers.

Acknowledgement

The authors are grateful to Mr.Nilratan ghosh of Naihati Fish Farm for providing considerable information related to trading at Fish Seed Market, Naihati, North 24 Parganas, West Bengal.

References

RAHAMAN, G.M. (1946) : A note on the fish trade in Bengal, Govt. of West Bengal, Calcutta. 1-55.

GANGULY, D.N. and B. N. MITRA (1957): The distribution of fry collection centers, methods of collection and the fry trade in the river Bhagirathi. *Geo. Rev*. India **19**:26-30.

MITRA, B.N. (1960-61) : The fish fry trade in Dhulian area, West Bengal. ***Jour. of the Science Club***.**14**:143-147.

Mitra, B.N. (1964): Preliminary studies on the collection of spawn, the nature of the trade and the condition of water of the river hooghly. *Ind. Agri.* **8(2)**. 82-86.

GHOSH, P.K. (1984): Note on Carp Seed trade at Kakdwip, West Bengal, *J.Zool.Soc.India*. **36 (1- 2)**: 126-129.

CHATTAPADHYAY, S.S. (1986): Fisheries and Rural Development. In : Second National Fish Seed Congress, Fisheries Dept. Govt. of West Bengal and Ministry of Agriculture, Govt. of India, Calcutta, July 3-4, 1986. pp. 18-19.

PAUL, S (1986) : Seed supply sub-system : key issue in economics of production and marketing. In : Second National Fish Seed Congress, Calcutta July, 3-4, pp. 72-74.

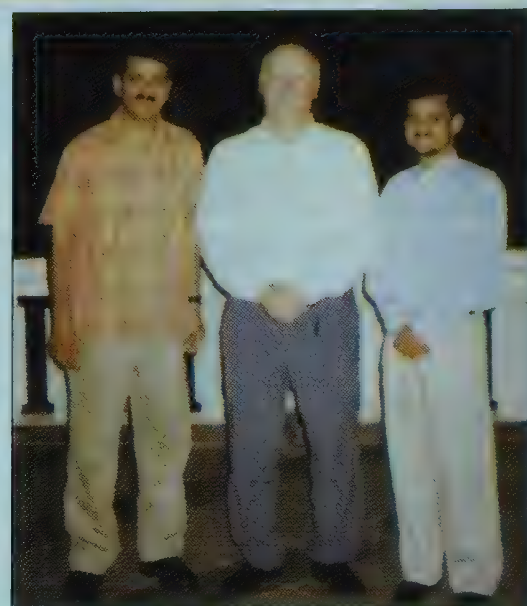
SENGUPTA, R.C.and A.K. SEN (1986) Fish seed trade is a self generating in dustry in West Bengal. In : Second National Fish Seed Congress, Calcutta. July, 3-4. pp. 79-80.

Interview

Indian Cultured Aquaproducts are of Prime Quality, & my company is a proud importer of quality Indian cultured black tiger and scampi, says Robert S. Hooey of Aquastar, USA

Robert S. Hooey with T. Raghunath Reddy, Managing Director, Suvarna Rekha Marine Exports Ltd.

Aquastar Inc. Seattle, USA, was founded by Robert S. Hooey. He was recently in Visakhapatnam on one of his business trips. His company is a major cultured aquafood importer from South Asia (Principally from India and Bangaladesh) and also from South-East Asian countries such as Thailand, Viet nam and Indonesia. Having developed confidence in the quality of Indian products after a trial purchase period of a few years, the company has been, since then, consistently importing cultured aquaproducts (Black Tiger and Scampi) from the production centres along the east-coast of India and also squids from the west-coast (Cochin) for the past several years, and by now the business relationship has become an established one.



Robert S. Hooey with M. Shyam Prasad (Right) and Abdul Salim Pasha of Red Chamber India

It is heartening to have the feedback from Mr. Robert S. Hooey, Executive Vice-President, Aquastar Inc., USA, according to which the quality of Indian cultured aquaproducts, (Black tiger and Giant Freshwater Prawn (Scampi)), has improved so much that they are now more or less in prime slot of imported aqua products into USA. He says that, of late, black tiger and scampi have been gaining appreciative acceptance among US customers, in contrast to earlier traditional disinterest among them towards Indian aqua products. Robert says that, considering the consistent and enormous improvement in the quality of exported Indian processed aquaproducts, India may soon emerge as the leader in the region in respect of cultured aquaproducts exports to USA.

Aquastar and Red Chamber are in one and the same US business group. So much so, Red Chamber, which has an office in India in Chennai, takes care of Aquastar's products purchase and export interests in India. The present annual level of imports by Aquastar from India is around 400 containers (2001).

Your Editor has had the opportunity of interviewing Mr.Robert S. Hooey during his recent visit to Visakhapatnam. The interview gave an insight into the dimensions of Aquastar's interest towards import of Indian cultured Aqua products into USA.Excerpts:

FC: I have heard about the discerning and selective approach of your firm in organising imports of cultured aquaproducts from India into USA and Canada. In this context, I value this opportunity to know more about your company's activities *vis-a-vis* Indian market.

RSH: I appreciate your perception about Aquastar. It will be my pleasure to tell about the activities of my company for the benefit of your readership.

FC: Is this your first visit to Visakhapatnam?

RSH: This is my second visit to Visakhapatnam and this time I am so happy to have the personal experience of upgradation in the processing scenario and the quality of the processed products at the various plants along the east coast and more so in and around Visakhapatnam.

FC: It is encouraging to hear this coming as it is, from a major importer of your stature. I am told that your company has by now developed an enduring and a mutually trustworthy business relationship in respect of purchase of cultured aquaproducts from some discerning Indian aquaproducts exporters, apart from similar relationships with the aquaproducts exporters in Bangla- desh, Thailand, Vietnam, Indonesia etc. In this background, could you enlighten me, as a preface, on the approaches adopted by

"The Quality of Indian cultured Black Tiger and Giant Freshwater Prawn has improved enormously. The products have, of late, gained an amazing acceptance among US customers, and this is in utter contrast to the hitherto general disinterest among them towards Indian products" : Robert S. Hooey.

your company to arrive at the present equation with Indian exporters?

RSH: Aquastar, set up by me with its headquarters in Seattle, USA, is now a ten year old company. All these years, while promoting the company's purchase activities in Thailand and other countries in SE Asia, simultaneously we extended our purchase programmes to India and Bangladesh. So far as India is concerned, our approach initially had been to organise purchase efforts, linked to a study of the quality of the products and export management style of Indian enterprises.

FC: Any particular reason for tempering purchases with a study of various export aspects?

RSH: To be frank, in the US market, until recently, most Indian aqua products are not well accepted traditionally. Keeping this in view, and considering that India is major a producer of aqua products, our company had to make a cautious entry supported by a careful study of the quality of the products. A few rounds of import of block frozen and IQF shrimp have convinced us about the quality aspect of Indian products.

FC: And that set the stage for expanding import of the products from India?

RSH: Yes, of course. In fact, the positive changes in the management style of the aqua products exporters in India have heartened me in a big way over the past several years. Now my Company is a proud importer of quality cultured black tiger and scampi from India.

FC: How wide is the product range of your imports from India?

RSH: Aquastar is a selective buyer. The company's main concentration is, as I said, on the import of cultured black tiger and scampi, in block frozen as well as in IQF form.

FC: Quantities imported last year?

RSH: Nearly 400 containers, of which a little over 300 are of black tiger and the rest mostly of scampi from east coast centres, and a few containers of squid too from Cochin.

FC: Who takes care of your export interests in India?

RSH: Ourselves. We have Red Chamber India (Indian Sourcing Company for Red Chamber Group, USA, of which Aquastar is a part) located in Chennai, which deals with all our export matters.

FC: Products of which Indian brand names you go in for?

RSH: All products purchased by us are packed for us under our own brand name 'Aquastar'. The design is made available by Aquastar to the exporters.

FC: Indian products under 'Aquastar' brand well accepted in USA?

RSH: Quality of 'Indian' Aquastar products is, in several ways, as good as the products imported from other countries of the region, if not better. While quality has received general acceptance, there are a few here and there in USA who continue to resist Indian products for traditional reasons, but this resistance, which is marginal, is gradually crumbling.

FC: Could you tell me more about Aquastar, its global spread of operations, your impressions in respect of Aqua products and their export situation in other countries?

RSH: Aquastar was established in 1990. Its primary line of business is import of aquaproducts into USA from countries specialising in culture of black tiger shrimp and giant freshwater prawn (Scampi). A major part of our expanding business, however, lies in the import of giant freshwater prawn into USA as well as Canada. It is a real giant in our business. Aquastar sells its products to all levels of trade, wholesalers, retailers and to major food chains. We have offices in USA in Seattle, Washington, New Jersey and in Toronto, Canada.

From Asian region, traditionally, Thailand is the major exporter of aquaproducts to Aquastar (and other also), followed by Indonesia and Vietnam as the next group. Bangladesh and India until recently constituted the third set of exporting countries to Aquastar (others too), but the position has now changed. India now stands separated from Bangladesh and is clubbed with Indonesia and Vietnam. Consumers, traditionally indifferent to Indian products, are now different and most of them are receptive to Indian products. The reason : The quality of Indian Cultured Black Tiger and Giant Freshwater Prawn, I mean Scampi, has improved enormously. The products have, of late, gained an amazing acceptance among US customers and this is in utter contrast to the hitherto general disinterest among them towards Indian products.

FC: It is good to know that Indian products have now swung into an upgraded slot. What future do you see, as a prime importer of cultured aquaproducts into USA and Canada, for the Indian exporting enterprises?

RSH: Gone are the days when the quality of Indian products was inconsistent and unreliable. Now the products exported are of excellent quality and I am proud to take them to US market. Further, the products are consistently better than what I see in other countries. The quality of giant freshwater prawn shell is very good having an attractive bluish grey colour as it should have. So much so, our business is expanding. US market is responding to Indian giant freshwater prawn very well and this has happened in a short time. Now, so far as my company is concerned, giant fresh-

Hooey observes that the present situation is so encouraging that his company may be able to offer better prices to Indian expoters in the near future. He adds: "The US market is now recovering. There will soon be good returns for the farmers as well as the exporters".

water prawn business from India equals black tiger business, thereby elevating my company to the status of an important importer of a diversified product from India. This year I expect that we will import 350 containers each of black tiger and giant freshwater prawn.

FC: At the moment the farmers as well as the exporters of black tiger and freshwater prawn are chagrined at the low prices that US importers pay.

RSH: The present scenario is a short term phase. The US market is now recovering. The present situation is so encouraging that my company may be able to offer better prices to Indian exporters in the near future. There will soon be good returns for the farmers as well as the exporters.

FC: What is your message to the Indian exporters?

RSH: Continue to maintain the quality standards and let there be no complacency about them. Diversify into value-added products such as P & D and cooked. Remember that consumers do not wait. In USA giant freshwater prawn is fast becoming popular. This can be fostered further.

Now India has the opportunity to be a leader among South and South-East Asian countries in the production and export of quality cultured Black Tiger and Scampi. I say this based on the transformed scenario that now prevails in India.

FC: How do you rate the support that the Indian Industry receives from its government, compared to the position in other countries?

RSH: To the extent I could see, the production, processing and export components of the industry in India are well supported by MPEDA and other governmental bodies as is the case in respect of government support in other countries of the region. However my impression is that the Vietamese industry gets a higher measure of support from their government. This can be one reason for the industry in that country coming up so well, with export earnings of that country growing up fast, coming closer and closer to Indian level.

Now India has the opportunity to be a leader among South and South-East Asian countries in the production and export of quality cultured Black Tiger and Scampi. I say this based on the transformed scenario that prevails now in India.

Workshop on Diversification in Aquaculture

MPEDA's sub-regional centre (Aqua), Kannur organised a one day Workshop on 'Diversification in Aquaculture on 20th February 2002 at Kannur for the benefit of Aqua farmers in Malabar region of Kerala State.

85 participants including officials from various disciplines took part in the Workshop.

Mr. O.V.Narayanan, District Panchayat President, Kannur, inaugurated the Workshop. Mr. G.Rathinaraj, Deputy Director, MPEDA, Regional Centre (Aqua), Kochi, presided over the meeting. Felicitations were offered by Mr. Issac John, Project Officer, Matsyafed Prawn Hatchery, Kannur and Mr. Balakrishnan Nair, President, Malabar Area Prawn Farmers Federation.

Technical sessions were held on: Prospects and Breeding techniques for freshwater ornamental fishes in Kerala by Prof. Sivarajan, Aiswarya Ornamental Fish Farm, Palghat;Better management practices to be adopted for sustainable shrimp farming by Dr.KM Sankar, Professor in Aquaculture, Fisheries College, Mangalore; Prospects and Breeding techniques for Marine Ornamental fishes in Kerala by Dr. Philippose, Senior Scientist, CMFRI, Calicut; and Prospects and Culture technology of Seabass, *Lates calcarifer* by Mr. Thampi Samraj, Project Director, I/C, RGCA, Myladuthurai.

After the technical sessions there was an open discussion and the farmers cleared their doubts from the concerned officials.

Project to popularise Fish Products

An annual Workshop on development and popularisation of modren techniques for the production of convenience fish products, a mission mode project under National Agricultural Technology Programme, was held at the Central Institute of Fisheries Technology (CIFT), Kochi recently.

In his introductory remarks, Director, CIFT, Dr.K.Devadasan, said that there was immense scope for the development of convenience food products out of fish in the country, and considering the potential of the internal market, which has so far not been exploited.

Exporters and the industry have been concentrating on the export market and no serious efforts have been made so far to popularise these food products domestically, he said, adding that, at this time when the export market was in the doldrums, efforts should be made for developing the internal market which would help the industry to survive.

It was pointed out that the institute now concentrating on the development of value-added products from low-value fish and their effective marketing. He observed that fishermen often discarded the low-value fish as byecatch as there would be only a few takers for these varieties in the market, he pointed out. These catches could be utilised as raw material for the production of value - added items. According to Dr. Devadasan, the country had not yet quantified the bye-catch that were being discarded by fishermen at sea. He expressed the view that, for this project to become successful, the products from low value fish had to be made acceptable and should be attractively packed for being sold through super markets.

The Institute had already received trade enquiries regarding fish products in retortable pouches in which the ready-to-serve fish products would have a shelf life of one year, Devadasan had pointed out.

Explaining other areas in which the Institute was working such as modified atmosphere package for marketing of fresh fish and fish waste products, he said that the Institute was given a financial assistance of Rs.113.6 lakhs from NATP for these research projects.

He mentioned that, under the three-year project, the CIFT would also work on a project for the development of attractive and nutritious fish-based extruded products using mince from miscelleneous low value fishes and other suitable ingredients. Evaluation of the quality of the products using these technologies and standardisation would also be undertaken, it was pointed out.

On the occasion, Dr. T.J. Pandian, National Professor, Madurai Kamraj University, Madurai, said that the research projects undertaken by CIFT served the cause of social justice while attempting to meet the growing demand for fish in the country. The development of value added products, which would also have high protein content, would meet the protein requirement of the masses, he pointed out.

Mr. K.M.Majumdar, Scientist Centre for Cellular and Molecular Biology, Hyderabad, also spoke on the occasion. Representatives of the fisheries industry took part in the discussions. Mr. Unnikrishnan, Principal Investigator of the project, presented a report of the project. Mr. K.G. Ramachandran Nair welcomed the gathering and Dr. Unnikrishnan proposed a vote of thanks.

Kanyakumari fishermen rescued: Strayed into Greek Waters?

Twelve fishermen from Kanya kumari district who were missing are reported to have been rescued off the coast of Greece according to a report of May 7 in New Indian Express.

These 12 fishermen from Azhikkal, a coastal village in the district set off for fishing on March 19, in a mechanised boat 'Mahimai Madha'. They had planned to return ashore on March 25 but did not do so until now. Coast Guard vessels and Dornier aricraft had been searching for them over the high seas.

Inquiries were also made through the ministry of external affairs, if these fishermen were in jails in Sri Lanka, Maldives or Pakistan. But the response was negative. Meanwhile, a report in the May 2 edition of **The New Indian Express,** Kochi published a **UNI** report, which said that 12 Indians had been arrested off the coast of Greece without passports in boat, some time last month.

Market Trends

(As in the week ending 02-05-2002)

Seafood International says : The market in Japan, particularly for shrimps, is slow, with low prices and poor demand because of the economic situation. With the recent appreciation of Yen against Dollar and onset of festive season, the market is expected to pick up. There is a good demand for major counts in Black Tiger, especially for 21/25 and 26/30 counts, with no significiant improvement for white and flower.

In USA, demand continues to be relatively good, but trading is slow because of high inventories. The supplies of Black Tiger Shrimp are steady, adequate for current needs.

Owing to the present situation in the EU, the prices are expected to fall in the short term.

The ban on imports from China yet persists due to high levels of chloramphenicol residues. As levels of chloramphenicol accepted in the USA are some what different than those accepted in Europe, the Asian Shrimp producers are stated to be suffering heavy losses.

The optimism about the cephalopod market has been set low. While the inventories are being reduced in the Japanese market, one may expect the prices to increase. Squid supplies are also lower. Cuttle fish catches are poor and there is at present a shortage of small sized whole cleaned cuttle fish. Prices for larger sizes are relatively stable.

The following are the rates that prevailed in the week ending 02-05-2002.

Item	*Count range*	*Price range($/kg)*
JAPAN		
HL BLACK TIGER		
Bhubaneswar	6/8 - 51/60	17.00 - 4.50
Bombay	8/12 - 26/30	17.00 - 2.40
Kolkata	8/12 - 51/60	17.00 - 6.20
Visakhapatnam	8/12 - 31/35	16.50 - 8.00
HL SEA TIGER		
Visakhapatnam	U/5 - 31/35	20.50 - 7.00
HL WHITE		
Mangalore	16/20 - 61/70	10.60 - 3.45
Mumbai	6/8 - 36/40	17.50 - 6.50
Visakhapatnam	11/15 - 51/60	15.50 - 4.80
HL FLOWER		
Mumbai	6/8 - 36/40	17.50 - 5.00
Visakhapatnam	6/8 - 36/40	17.00 - 5.60
HL BROWN / PINK		
Mangalore	16/20 - 71/90	8.65 - 3.50
Visakhapatnam	16/20 - 51/60	8.00 - 3.70
PUD SHRIMP		
Bhubaneswar	60/80 - Broken	5.30 - 1.80
Kochi	80/120 - 300/500	4.80 - 2.90
Kolkata	80/120 - Broken	4.75 - 2.00
Mangalore	80/120 - Broken	4.75 - 1.55
Visakhapatnam	U/10 - Broken	8.50 - 1.80
WC LOBSTER		
Mumbai	U/80 - 450/500	6.20 - 14.00
USA/CANADA		
HL BLACK TIGER (lb)		
Visakhapatnam	8/12 - 51/60	7.00 - 2.90
Kochi	16/20	4.85
Chennai	8/12 - 51/60	7.80 - 2.80
HL BLACK TIGER SHRIMP (lb)		
Chennai	8/12 - 41/50	7.80 - 3.20
HL SHRIMP		
Chennai	6/8 - 21/25	6.30 - 2.50
HL SCAMPI		
Kochi	13/15 - 16/20	4.00 - 3.00
PUD SHRIMP		
Kochi (lb)	80/120 - 300/500	2.20 - 1.12
Kochi	80/120 - 200/300	5.20 - 3.40
HL WHITE SHRIMP (lb) (Peel and Eat)		
Kochi	41/50 - 250/350	3.20 - 1.65
FISH		
a) Silver promfret		
Kolkata	300/400 - 500/UP	4.50 - 6.30
b) Mackerel Whole (IQF)		
Kochi	5/8	0.50
SQUID (WC) (lb)		
Mangalore	U/5 - 20/40	1.12 - 0.85
EUROPE		
HL BLACK TIGER		
UK	21/25 - 41/50	8.30 - 5.60
Netherlands	51/60	4.80
HL WHITE		
UK	21/25 - 41/50	9.60 - 5.65
PUD SHRIMP		
UK	80/120 - Broken	4.20 - 1.70
Germany	20/40 - Broken	8.10 - 1.80
PUD		
UK	100/200 - Broken	3.75 - 1.55
Belgium	20/40 - 60/80	7.70 - 5.60
Netherlands	80/120	4.75
SQUID		
Spain (Whole)	U/3 - 6/10	2.30 - 1.75
Spain (Whole Round)	U/3 - 6/10	2.25 - 1.80
UK (Rings)	60/UP	4.95
Netherlands (Tentacles)	60/UP	1.30
CUTTLE FISH		
Spain (WC)	2/4 - 8/12	3.36 - 2.50
Spain (IQF)	U/1 - 1/2	2.90
SOUTH EAST ASIA & CHINA		
HL BLACK TIGER		
Vietnam	31/40 - 61/70	8.30 - 5.10
PUD SHRIMP		
Thailand	300/500 - 500/900	2.95 - 2.35
China	300/500 - 500/800	3.20 - 2.85
FISH		
a) Ribbon fish		
Hong Kong	100/200 - 700/UP	0.44 - 0.74
China	100/200 - 400/UP	0.45 - 0.75
b) Yellow Croaker		
China	100/200 - 300/UP	0.67 - 0.92
c) Silver Croaker		
China	100/200 - 300/UP	0.70 - 0.95
d) Mackerel		
Malaysia	2/4 - 10/12	0.90 - 0.80
CUT CRAB		
Korea	U/13 - 41/50	2.45 - 1.70
STINGRAY FISH SKIN		
Thailand	6" to 12"	1.75
MIDDLE EAST		
PUD SHRIMP		
Dubai	100/200 - 200/300	3.70 - 2.80
REEF COD (IQF) (IWP)		
Lebanon	2/5 kg	1.60

(Source: *Prime of MPEDA & Seafood International*)

Seminar on

"Sustainable development of fish culture in Jharkhand State"

Ashish Kumar
Deputy Director of Fisheries
Directorate of Fisheries, Jharkhand, Ranchi-834 002

A seminar was organized by the Department of Fisheries, Jharkhand state on "Sustainable Development of Fish Culture in Jharkhand state" on 22 March, 2002 at Ranchi. It was inaugurated by Mr. Babulal Marandi, Chief Minister of Jharkhand under the chairmanship of Mr.Devidhan Besra, Minister of Animal husbandry and Fisheries, Government of Jharkhand. Mr. P.K. Jajoria, Secretary and Mr. Rajiv Kumar, Director of Fisheries were among the distinguished participants.

In his inaugural address, the Chief Minister emphasised the enormous scope for development of Fisheries in the State. He observed that the developmental process could pick up faster, only when those already motivated were taken to places where fisheries were very much developed and were enabled to see for themselves the operations elsewhere and the benefits being reaped by the fishery enterprises in other States. A pre requisite to set the developmental process in motion was to first identify the areas most suitable for development of fisheries and to formulate programmes for their implementation in those areas. He lauded the efforts being made by the department in Deoghar district where a hatchery had just been constructed and the farm was going to be renovated soon. He exhorted the departmental officers to develop demonstration farms at several centralised located places in the State.

The Minister for fisheries reminded the participants that Dairy, Animal Husbandary and Fisheries were related to the culture of the people of Jharkhand and were in vogue since time immemorial. So much so, by introducing a scientific methodology for promotion of these activities, better results could be obtained. He said that development of reservoir and pond fishery development sectors in an organised manner based on the latest available technologies would make the State independent of other States. He cautioned the officials to avoid perfunctory way of implementation of the schemes and directed the senior officials to remain on continuous vigil to ensure that the benefits go to farmers directly out of activities such as construction of ponds or training or seed distribution, etc.

The Secretary, fisheries, gave the good news that allocation of funds to Fisheries sector of the State had been increased several fold and there was no dearth of funds for taking up fruitful projects for the development of this sector. He had pointed out that newer projects such as those for the development of reservoir fisheries had been taken up this year under which Getalsud and Hatia reservoirs had been stocked with advanced fingerlings in large numbers and similar programmes for other reservoirs were planned to be taken up for stocking next year. This would boost production of fish in the State many folds, he said.

The Director spoke on the following ongoing fisheries schemes of the department: a) construction of 100 houses for fisher families in Palamau, West Singhbhum and Dumka districts b) excavation of ponds on the private lands of farmers; c) seed distribution; d) composite fish culture in departmental farms; e) demonstration of fish culture in private fish farms; f) stocking of late fingerlings in reservoirs; g) duck-cum fish culture; h) training to fish farmers; and i) subsidy to private fish seed growers, etc.

He gave an assurance to fulfill the expectations of the Chief Minister by effectively implementing various fisheries schemes in different parts of the State.

The author functioned as the Master for ceremony. Vote of the thanks was proposed by Mr. Lalan Bihari Sharan, Executive Engineer (Fisheries).

Technical Sessions

There were three technical sessions: 1) Pond Fish Culture; 2) Appropriate Fisheries Extension Methodology; and 3) Reservoir Fisheries

In the light of the various papers and the discussions thereof at the various sessions, the following recommendations were made:

Recommendations

1) The available data on the water resources of the State should be updated to make effective plans for fisheries development.
2) The old and silted ponds should be reclaimed in phases so as to increase fish yield from them.
3) The rate of sale of fish seed should be lowered from existing Rs.100/- per thousand to Rs.35 to 40/- per thousand.
4) Seed of fast growing fish species like Catla, Silver carp, Grass carp and Common carp should be stocked in seasonal as well as long seasonal ponds.
5) Availability of fish spawn for supply to hatcheries should be ensured by the Department of Fisheries. Hatcheries and nearby fish farms should be identified so that timely availability of seed to the farmers can be ensured.
6) All the departmental fish farms should be renovated with an assured

water supply.

7) The seasonal and long seasonal ponds should be used as rearing ponds and late fingerlings produced from them should be purchased by the Department of Fisheries for sale to the farmers or stocking in reservoirs. Needed facilities in this regard should be set up.

8) The progressive seed growers and farmers should be sent to other States on study tours and they should be encouraged in this regard by offering subsidies.

9) Future fishery development activities should be area-based, considering the availability of resources and willingness of people.

10) Effective plans should be made to ensure availability of quality fish seed throughout the year.

11) Ideal fish farms should be established in all the districts of the State where various aspects of fisheries can be demonstrated to farmers.

12) Fish production should be undertaken in check-dams and coal-quarries which are available in large numbers in the State.

13) Areas with a large number of water bodies should be identified and intensive fish culture should be started in them.

14) In case of outbreak of disease, supply of drugs to the farmers should be ensured by the State Fisheries Department.

15) Short-duration training courses in newer techniques should be arranged for extension workers and officers of the department.

16) Fish farmers' Meets at Panchayat level should be arranged at regular intervals to discuss problems of farmers.

17) Demonstration of fisheries and integrated fish culture should be undertaken extensively so that more and more people should know about the benefit of fish culture.

18) NGOs and Birsa Agriculture University should also be consulted while formulating plans for future development.

19) Extension materials related to different aspects of fisheries should be published and distributed among farmers.

20) Biotechnology and Information technology should be incorporated in fisheries course.

21) A separated reservoir development cell should be established in the Directorate of Fisheries.

22) Plans for development of fisheries of reservoirs of the State should be drawn after a careful study of successful fisheries development in reservoirs of other States.

23) Stocking of more than 15 cm. size fingerlings should be ensured in reservoirs.

24) Participation of farmers and displaced persons should be ensured while stocking the reservoirs.

25) Pen culture should be undertaken in the reservoirs with the participation of farmers of neighbouring villages.

26) The area of operation of State Fisheries Research Unit should be extended to cover the entire State.

27) Fish-cum-Prawn culture should be experimented in departmental and private ponds. The fisheries research unit of Jharkhand should have contacts with other fisheries research units of the country for exchanging information;

28) Soil and Water testing of fish ponds should be taken up in a larger way;

29) In order to study the potential of "Sewage fed fisheries" a team comprising Dr. D.K.Sadhu, Head of Zoology Department., Binova Bhave university, Hazaribagh, Executive Engineer and Asst.Director, Research should be constituted, and

30) The procedures for settling of fisheries of revenue tanks should be revised with a view to leasing the ponds to the villagers of the same village where the pond exists.

The seminar concluded with a vote of thanks by Mr. L.B.Sharan, Executive Engineer.

Training to J & K Fish Farmers at CIFA

Major carp fish culture is gaining popularity in the semi tropical/tropical belt of Jammu & Kashmir. The Regional Fish Farmers Development Agency, Chattabal has succeeded in popularising the activity in J & K and achieving a production of 8-10 tonnes per crop during the year 2001-02 from privately owned fish farms. Encouraged by the success, the State Fisheries Department, Jammu & Kashmir, deputed a group of 20 fish farmers and few young entrepreneurs to the Central Institute of Freshwater Aquaculture, Bhubaneswar, for developing an awareness of various aspects of freshwater fish culture and also to gain knowledge on farm maintenance, care of crop, and on harvesting technologies. There are also plans to send the candidates for further training to CIFA during monsoon season to enable them to pick up knowledge on major carp breeding, hatchery technology and raising of carp seed. The trainees have expressed their gratefulness to Senior Project Officer, Fisheries, RFFDA, Chattabal, Srinagar and also to the Central Institute of Freshwater Aquaculture for the exposure given to them in respect of technologies and for the training provided.

Some of the fish farmers and entrepreneurs of J& K at CIFA, Bhubaneswar

Chhattisgarh Newsletter

From : R.P. Tuli

The new State of Chhattisgarh has recognised fisheries as an important component of rural development. This is discerned from the greater focus directed at fisheries activities in the tribal areas of the State. Top leadership including the Governor and the Chief Minister, have visited fisheries centres in the areas and appreciated on-going activities. On the occasion of Republic Day celebrations on 26th Jan 2002 at Bilaspur, the Chief Minister had publicly acknowledged that the Fisheries Department was one of the best development departments of the State. This augurs well for the future of fisheries development in the new State.

Fish Production

0.96 lakh t of fish are reported to have been produced in Chhattisgarh during 2000-2001 which is about 24% more than the previous year. Private sector share in the fish production of the State was 99%. Resource wise, village ponds etc., contributed to 92.19% of the fish production of the State.

Details of sector-wise and resource-wise fish production are given in the Table below.

Sector	*Ponds*	*Reservoir*	*River*	*Total*
Private Effort (ha)	89.115.93	6.186.37	574.07	5.876.37 (99.18%)
Public Sector	--------	784.581 (ha)	-----	784.581 (0.81%)
Total	89.115.93 (92.19 %)	6970.951 (7.21%)	574.07 (0.59%)	96.660.951

Major share in fish production comprises carps. Fish productivity of village ponds ranges from 902 kg/ha in Bastar area to 2976 kg/ha in Rajnandgaon area. Average fish production from tanks and ponds is estimated to be 2193 kg/ha which is close to the national average.

Fish Seed Production

Same way as in the case of culture fish production, private sector is playing a leading role in fish seed production too. Out of production of 287 million standard fry in 2000-2001, 62.36% was contributed by the private sector. It is reported that 439.68 million standard fry was stocked of which 35% was procured by private sector from outside the State. Its share in stocking was 97%. Details of production and stocking are given hereunder.

(in million nos)

Sector	*Seed production*	*Procurement*	*Stocking*
Private sector	179.019	152.680	426.702 (97.04%)
Public sector	108.062	---------	12.978 (2.95%)
Total	287.081	152.680	439.680

As may be seen, substantial quantity of seed is produced by the private sector as its own production falls short of requirement. It is therefore necessary to take steps to augment production in the private sector, even after taking into account surplus public sector seed production that is sold to private sector.

Culture of Giant Freshwater Prawn

It may be recalled that during 1994, a project with an outlay of Rs. 98.93 lakhs was sanctioned by the Department of Bio-technology, Govt. of India for demonstration of farming of *Macrobrachium rosenbergii*, the gaint freshwater prawn in Madhya Pradesh. Madhya Pradesh Council of Science & Technology was the nodal agency of the project. Under the said project it was proposed to set up Prawn Hatchery and Prawn Feed Mill, apart from demonstration of Prawn culture.

The proposed hatchery could not be established although efforts were made at Khutelabhata (Durg) farm for producing post larvae of the species by utilizing a small infrastructure created earlier based on CIFA design. However, annual production was always far below 0.02 million post larvae.

Prawn culture trials undertaken in Chhattisgarh area during 1994-97 period, however, have given encouraging results. Durg and Raipur proved potential areas both for mono and polyculture of Prawn. Production of 66 kg of prawn and 1000 kg of fish per hectare could be achieved from polyculture of prawn and fish. In monoculture per hectare upto one ton production of prawn could be attained in a single crop.

After the formation of Chhattisgarh in Nov. 2000, the new State has shown keen interest in the promotion of prawn farming. It is learnt that the State cabinet has now taken a decision in principle to go in for a joint venture with an Indian entrepreneur to demonstrate commercially viable and export-oriented Prawn farming. Trials in this regard have already begun at Demar Fish Farm (Dhamtari) in an area of 4 ha, by an Andhra Pradesh-based entrepreneur. Apart from this, polyculture has been initiated at six places, consisting of culture of *Macrobrachium malcomsonii* with fish and this is being done in Ambikapur and Raigarh, and culture of *M. rosenbergii* alone (monoculture) has been undertaken in Jagadalpur, Dantewara, Bilaspur and Durg areas. At Dantewara and Jagadalpur, prawn seed is given on 100% subsidy to tribals. The prevailing interest in prawn farming is a welcome feature but there are a few areas which need to be addressed.

Availability of prawn seed is the main constraint. This need cannot be met for all time through procurement of seed from other states. It would be worthwhile if some concrete steps are taken in this regard by using existing infrastructure at Khutelabhata which has potential for producing upto 0.1 million post larvae. It has been reported (*Fishing Chimes* Jan-Feb 2002) that in Vietnam it has been possible to establish a large number of backyard prawn hatcheries in areas away from sea. This became possible on account of use of Modified Green Water system developed in that country for rearing of prawn larvae. In this system there is no water exchange, hence sea water requirement was minimal. It would be useful if CIFA looks into this aspect and develops and demonstrates a package of practices for taking prawn seed production into the hinterland of India, following the systems adopted in Vietnam.

Of late, leading scientists of the country have been proposing rearing of Tiger shrimp in freshwater where its growth was found to be good. Trials on this aspect also need to be made at Demar Fish farm which has 25 ha water area. Upto 60% of its area can be considered for shrimp farming trials and rest can continue to be used for major carp seed production.

Freshwater Pearl Culture

For the first time freshwater pearl culture has been successfully accomplished by scientists of Krishi Vigyan Kendra, Bilaspur who had earlier received training at CIFA. This success has opened new opportunities for fish farmers of Chhattisgarh. The host mollusc *Lamellidens marginalis* is reported to be available in nature and can multiply in perennial ponds. The State Fisheries Department should take a further lead and make trials, preferably in farmers' ponds. Its scope for marketing both local and outside the State, and also economics of operation need to be studied before embarking on an action plan for initiating the activity in selected areas.

Gambusia affinis culture

Gambusia affinis, known for its effective use in the control of mosquitoes, is being produced by Fisheries Department at its Raipur Centre. O.75 lakhs of *Gambusia* of 2 cm size have been produced in 2000-2001.

This year production of the fish has gone upto 2.5 lakh nos. The fish is being sold at Rs. 50/- per 1000 numbers to local bodies in Kanker, Durg, Bilaspur and Shahdol districts. It is a hardy fish and breeds several times in a year. Its production can be extended to the interior areas through private sector for which Fisheries Department can impart hands-on training to fish farmers in areas mosquitoes are a likely threat to the local population.

Production of Seed of Indian Magur

Notwithstanding the popularity of exotic Thai magur, which has been introduced clandestinely into the country by vested interests, Indian magur continues to be the first choice of the consumer. The main constraint in the spread of magur culture has been the shortage of seed. Although its breeding is not much of a problem, the main hindrance has been the large scale mortality in the larval stage after absorption of yolk sac. Efforts made by the fisheries department at Raipur have improved survival from earlier 11% to about 30-40% now. On account of this production of fry per kilo of female weight has gone up from 1,400 to 6,000 numbers according to local fisheries officers. It is learnt that improvement in survival was due to feeding with very small sized zooplankton and application of liquid feed in the form of egg emulsion. To make up for the deficiency of breedable stock of the fish, the department has decided to raise broodstock in adequate numbers at its own centre. For this purpose 7,000 fish seed are being reared separately. The department appears to be now well set for increasing production of magur seed.

Culture of Feather back

The fisheries department has succeeded in locating breeding ground of feather back (*Notopterus chitala*) near Simga of river Shivnath, a tributory of Mahanadi river. 50-80 mm size fingerlings have been raised. In Nov. 2001, fingerlings have been released in some ponds for growing them to table size. It is learnt that fish has grown upto 150 g in weight in about 4 months time. Chitala is a highly predatory fish. Joint Director Fisheries, Raipur division, who has initiated this work, intends to use them for control of unwanted fish in selected ponds. Chitala is a highly valued fish and fetches a price higher than what is commanded by major carps. It shall be worthwhile to use Chitala in some Tilapia infested tanks not only for control of unwanted population but also for rearing a high value fish for the benefit of fish farmers.

Obituary

S.K. Sinha leaves mortal world

Mr. S.K. Sinha, Regional Manager, Matsya Mahasangh, Raipur, has left for his heavenly abode in March 2002. His services for the cause of fisheries development in undivided Madhya Pradesh and in Chattisgarh were immense and they stand as a symbol of his dedication. May his soul rest in peace. (This newsletter is dedicated to his memory.)

Trainers Training Course on Marine Electronic Equipment for Fisheries

A training course with a 5-day duration on marine electronic equipment including fish finder, GPS and RT, was conducted at CIFNET, Kochi, from 25 February to 1 March 2002. Eight representatives of boat operators Association from Kolkata, Bhubaneswar and Maharashtra regions and 2 officials from MPEDA particpated in the programme. The objective of this programme was to impart knowledge of modern marine electronic equipments in capture fishery systems. The practical training was conducted in the vessel 'Prashikshani'.

Orissa Newsletter

***From* : H.S. Badapanda**

Chilika Fishing (Regulation)

Bill referred to Review Committee : Mr. B. Harichandan, Minister for Law & Revenue, Fisheries and ARD, Orissa placed Chilika Fishing (Regulation) Bill, 2002 before the State Assembly on 3rd April, 2002. He told the house that Orissa's economy was deeply associated with the profession of about two lakhs fishermen and non-fishermen living in the peripheral belt of the lake and therefore the Govertnment had a open mind to have thorough discussion on this Bill. The Bill has provision for lease of about 47,000 acres of area to both fishermen and non-fishermen at the ratio of 70% and 30% respectively. The Collector will lease out this area to FISHFED (A Govt. of Orissa undertaking) and subsequently the FISHFED will sublease the same to both fishermen and non-fishermen conducting fishing in the lake.

Some of the members opposed the Bill stating that about 15,000 power boats were operating inside the lake daily adding immensely to pollution. The boats were using small-meshed nets for fishing. As a result lot of juveniles were being killed mercilessly imbalancing natural recruitment to the lake. In addition there had been clashes between fishermen and non-fishermen very frequently. The members said that there was no provision in the Bill to control these problems and requested the Minister to refer the Bill to "Review Committee" for necessary amendment. This demand came both from the treasury and opposition benches after which the Minister agreed to refer it to the "Review Committee".

New Ports Development

The Govt. of Orissa has decided to develop eleven ports in the State including Gopalpur and Dhamra. A policy has been drafted for the development of such ports and it is in the final stage of approval. Mrs.Murmu, Minister of State and Transport indicated in the State Assembly said that action as suitable would be taken after the policy was approved by the cabinet. The minister also stated that the State Government had signed agreements with two private companies for development of Gopalpur and Dharma ports for which the preliminary examinations were over. The new ports identified for developments were Kirtania, Chandipur, Inchudi, Chudamani, Barunei, Astranga, Baliharachandi, Palur and Bahuda in addition to Gopalpur and Dhamra.

Biggest Dry Fish Market at Huma in Trouble

The biggest dry fish/salted fish market of Orissa is at HUMA in the district of Ganjam. The market functions once a week on every Saturday. Business people from the districts of Gajapati, Puri, Paradeep, Chilika and also Andhra Pradesh assemble there for marketing. The business is run mainly by women. A business turnover of about 10 mt. of dry/salted fish takes place on the week day. Though lot of revenue is earned by the market lease, there is no arrangement to provide security for the women. The Gangadevi Mahila Vikash has lodged a complaint before the Collector, Ganjam in this regard. It has been appealed to the government to look to the minimum security and welfare of the business women to avoid unwarranted harrassment in future.

Protection of Olive Ridley

A Far Cry : As per provisions in the Wild Life Protection Act (Schedule I) 1972 the sea turtles have been declared as endangered species. In a survey conducted jointly by the Turtle Protection Committee and Wild Life Society of India, it has been estimated that 75,000 Olive Ridley turtles have been killed during a span of last six years. During 2001-02 upto January, 2002 the deaths in Gahirmatha were 2900; from Paradeep to Devi estuary 2551, from Devi mouth to Baduka and Baduka to Chilika 3209 and from Chilika mouth to Rusikulya estuary the deaths were 1542. In total 10,202 Olive ridley have died upto January, 2002. In 1999 the Indian Oil Corporation provided an amount of one crore of rupees for their protection, but during last 3 years not a single rupee has been so far spent for the purpose. No speed boat is said to have been purchased though Govt. of India provided an amount of Rs. one crore for the purpose four years back. As per 1997 regulations no trawl net should be permitted to be operated without TED. In November, 2001 there was a Workshop on protection measures and in February, 2002 another 3 day symposium had been organised at Paradeep on the subject. Steps are needed to protect this endangered species with the help of police, forest officials, coast guard and fishery officials.

Another report of 19 March, 2002 indicates that though 6000 turtles came to lay eggs in the Devi river estuary last year; this year no significant laying has been observed there. A report of 5 April, 2002 also indicates that even at the Rusikulya estuary only 2000 turtles have laid eggs this year though about two lakhs laid eggs last year. It is generally felt that the organisations which are provided with funds and authority do not work with dedication. For this season it is felt that the scheme is going from bad to worse and therefore calls for more attention both from Govt. and Non-Govt. levels.

In the meantime, the Orissa High Court has issued notices to the government to let it know how the instructions of the Court are being followed to protect sea turtles in Gahirmatha as issued in 1998. Referring to a case of public interest filed by Mr.B.Mohanty, the Court issued notice to the government to arrange armed guards and for fitting of TED in fishing trawlnets. The Division Bench comprising Justice P.V.Nayak and Justice P.K.Mohanty reviewed the case and issued notices to the Revenue Divisional Commissioner (CD)

Cuttack and Collector, Jagatsinghpur to report the steps presently taken against the decision.

The issue of protection to turtles also came up in the State Assembly on 8 March, 2002. Replying to a query, the Minister of Finance Mr. R.K.Pattnaik replied on behalf of the Minister for Forests and Environment and stated that though there had ben considerable arrival of turtles on the Orissa coast, the laying of eggs had not been so far satisfactory, the peak period of laying being February 28th to 5th of March. He informed the house that so far 250 TEDs had been distributed to trawler owners free of cost. An area of 1430 sq.km. of Bhitarkanika area had been declared as sanctuary and fishing free zone. In addition the coast guard had been positioned to look to the protection strategy properly for which Divisional Forest Officer, Paradeep had been positioned to implement the protection strategy properly and Divisional Forest Officer, Paradeep had been asked to co-ordinate the process. The Minister further stated that a radius of 20 km near Devi River mouth and Rusikulya mouth had also been declared as no-fishing zone. There had been instructions also to see that no trawl fishing took place within 5 km distance from the coast line.

Concern over Deforestation of Mangrove Plants : Once a deep green belt of Mangrove forest was in existence in Basudevpur Tahsil with a length of 33 km and breadth of 3 km from Basudevpur to Dhamra. This green belt was giving protection to its hinterlands since time immemorial. This invaluable forest wealth is poised to be extinct due to large scale exploitation in the area without protection and fear of future cyclonic damage as had taken place in 1971 and 1982. Such damage if occurs would bring miseries to lakhs of people.

Hookitola is known as the second Chilika and harbours several species of birds, crocodiles, dolphins, etc. There are reports of mangrove cover having been cut at Hookitola, Kansarigudia, Kandarapatia, Jamu and Light house region by the shrimp mafias recently eliminating large area of mangrove forests.

Trawlers Seized

One Andhra Pradeh Trawler has been seized by Coast Guard and handed over to the Forest Officials of Jamu while conducting fishing in Agarnasi sea near Hookitola with the help of forest officials. The coast guard has also seized 12 trawlers while conducting fishing in the prohibited territory in Bay of Bengal. All the trawlers have been put to anchor at Jamu lock and cases have been filed against the miscreants.

Group Clash : Village Deserted

More than a hundred fishermen have deserted their village Kantiagarh and are residing on the sea shore due to group clashes between fishermen and non-fishermen. Complaint lodged before the Superintendent of Police, Ganjam indicates that the repeated attacks by non-fishermen group in the village have brought miseries to the fishermen group and therefore they have shifted from the village. They also requested to the Superintendent of Police, Ganjam and Addl. District Magistrate to allot them separate land for their settlement. The A.D.M. has promised to make an inventory survey on the site and to do the needful. But no person so far has been taken into custody. It was recalled that since the year 1984 ten such clashes did occur in the village but no concrete steps could be taken by the adminstration though regular appeals were made time and again. This has prompted the miscreants to lift their head without any fear or repentance. It has been further reported that the Governor of Orissa laid a foundation stone for a fish drying platform in the village for which work order was being executed by the women's group. The non-fishermen afterwards opposed to the execution of this order and the recent clash was attributed to this. It has been appealed to solve the issue at the earliest to avoid recurrence in future.

Ansupa Renovation in the Offing : A high level meeting was conducted in the Panchayat Office of Subarnapur near Athgarh in the presence of Mr.Ajit Kumar Tripathy, Principal Secretary to Govt. Finance Department, Orissa. He indicated that one Ansupa Development Board would be constituted similar to the Chilika Development Authority (CDA) and an amount of 4 crores of rupees would be spent for renovation of Ansupa lake. This amount had been allocated by Eleventh Finance Commission. It can be said that Ansupa is the largest freshwater lake of the State and harbours lots of fish. It is also indicated that an organisation called "AWARE" is working with the Dept. of Water Resources, on the Project. Andhra Pradesh, will help in the preparation of the development report and the connecting canals like Huluhula with river Mahanadi would also be reclaimed to keep connection with the river year round. To save soil erosion extensive plantation would be undertaken in the catchment area of the lake. The project Director, DRDA, Cuttack, the Sub-Collector, Athgarh, the Tahasildar, Athgarh also attended the meeting along with other officials.

Plan for Hygienic Food Processing Facility in Kochi

An accelerated radiation based processing facility has been proposed to be set up in Kochi for ensuring quality in foods through elimination of pathogens and parasitic organisms.

The unit which is to be promoted jointly by Delhi-based Small Farmers Agri Business Construction (SFAC), Kerala Industrial Infrastructure Development Corporation (KINFRA) and private entrepreneurs, is expected to cost around Rs. 10 crores. KINFRA is entrusted with the preparation of a feasibility report for the project, which is likely to be located at the KINFRA park at Kakkanad, near Kochi. The Agriculture Finance Corporation will provide the inputs on techno-economic feasibility.

According to SFAC Managing Director, Mr. Sudhir Kumar, the organisation has selected Kochi for locating the project because of the presence of facilities and seafood exporters.

SFAC is promoted by the Union Government, RBI, IDBI, NABARD, SBI, Oriental Bank of Commerce with the objective of helping farmers to achieve value addition. It has primary membership of Canara Bank, United Phosphorus Ltd. and NAFED.

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